VOLUME 70 • JULY 1959 • NUMBER 1

# A.M.A. ARCHIVES OF OTOLARYNGOLOGY

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Studies on the Reactivity of the Mesenchyma of the Paranasal Sinuses
*Jan Malecki*

Personal Observations of Stapes Footplate Fenestration
*Alan Austin Scheer*

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*Sjarif Thajeb, Muzaffer Kurkcuoglu, and Arthur E. McElfresh*

Otosclerosis
*Edmund Prince Fowler*

Multicentric Origin of Glomus Jugulare Tumors
*Richard A. Buckingham, Kenji Aimi, and S. L. Perrelli*

Esophagitis Edematosa Circumscripta Chronica
*Shoji Niho and Kazuhide Yasuda*

A Check on Oto-Chek
*Charles Lightfoot, Richard A. Buckingham, and Mary Neville Kelly*

The Perceptual Process in Speechreading
*John B. Brannon Jr. and Frank Kodman Jr.*

Unusual Tumors of the Nose
*Stephen F. Balshi*

Lye Burns of the Esophagus Treated with Steroid Therapy
*William DesPortes and Edward S. Ray*

Treatment of Lateral Nasal Wall Tumors Through Lateral Rhinotomy Approach
*Bernard M. Kramer and Gordon McCoy*

Congenital Choanal Atresia
*Robert G. MacLean and William Hammock*

The Combination of Antimicrobials and a Corticoid (Florotic) for Treatment of Otitis Externa
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# TABLE OF CONTENTS

VOLUME 70 JULY 1959 NUMBER 1

## ORIGINAL ARTICLES

PAGE

**Surgery for Bilateral Bony Atresia of the Posterior Nares in the Newborn**
*Henry H. Beinfield, M.D., Brooklyn* ..... 1

**Surgical Hearing Rehabilitation of the Chronic Suppurating Middle Ear**
*L. García-Ibañez, M.D., Barcelona, Spain* ..... 8

**Primary Hemangioma of the Nasal Bones**
*Fred W. Beck, M.D.; C. W. Bunnell, M.D., and R. E. Swenson, M.D., Oakland, Calif.* ..... 19

**Ciliary Beat Rates in Sinus and Bronchial Mucosa from Bronchiectatic Persons**
*Tore Dalhamn, M.D.; Gösta Evert, and Torbjörn Fahlén, Stockholm, Sweden* ..... 25

**Primary Diphtheritic Otitis Media**
*John J. Downes, M.D., Tacoma, Wash.* ..... 27

**The Otolaryngologist and the Symptom of Hyper-Rhinolalia**
*Esti D. Freud, Ph.D., New York* ..... 32

**A New Approach to Surgery of the Lower Cartilaginous Vault**
*Edward M. Lipsett, M.D., Beverly Hills, Calif.* ..... 42

**Anesthesia for Tonsillectomy and Adenoidectomy**
*W. E. Pembleton, M.D.; Thomas Walker, M.D., and John A. Gill, M.D., Richmond, Va.* ..... 48

**Ruptured Intracranial Carotid Artery Aneurysm with Fatal Epistaxis**
*Daniel M. Seftel, M.D.; Harry Kolson, D.D.S., M.D., and Benjamin S. Gordon, M.D., New York* ..... 52

**Malignancies of the Paranasal Sinuses**
*William G. Hemenway, M.D., and John R. Lindsay, M.D., Chicago* ..... 61

**Studies on the Reactivity of the Mesenchyma of the Paranasal Sinuses**
*Jan Malecki, M.D., Poznan, Poland* ..... 65

**Personal Observations of Stapes Footplate Fenestration**
*Alan Austin Scheer, M.D., New York* ..... 69

**The Value of Systemic Hemostatic Drugs**
*Sjarif Thajeb, M.D., Jakarta, Indonesia; Muzaffer Kurkcuoglu, M.D., and Arthur E. McElfresh, M.D., Philadelphia* ..... 72

**Otosclerosis**
*Edmund Prince Fowler, M.D., New York* ..... 75

**Multicentric Origin of Glomus Jugulare Tumors**
*Richard A. Buckingham, M.D.; Kenji Aimi, M.D., and S. L. Perrelli, M.D., Chicago* ..... 94

**Esophagitis Edematosa Circumscripta Chronica**
*Shoji Niho, M.D., and Kazuhide Yasuda, M.D., Yokohama, Japan* ..... 98

## AUDIOLOGY SECTION

**A Check on Oto-Chek**
*Charles Lightfoot, Ph.D.; Richard A. Buckingham, M.D., and Mary Neville Kelly, M.Ed., Chicago* ..... 103

**The Perceptual Process in Speechreading**
*John B. Brannon Jr., M.A., and Frank Kodman Jr., Ph.D., Lexington, Ky.* ..... 114

## CASE REPORTS

**Unusual Tumors of the Nose**
*Stephen F. Balshi, M.D., Philadelphia* ..... 120

**Lye Burns of the Esophagus Treated with Steroid Therapy**
*William DesPortes, M.D., and Edward S. Ray, M.D., Richmond, Va.* ..... 130

*(Continued on next page)*

# A. M. A.
# ARCHIVES OF OTOLARYNGOLOGY

VOLUME 70 JULY 1959 NUMBER 1



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## TABLE OF CONTENTS (Continued)


Treatment of Lateral Nasal Wall Tumors Through Lateral Rhinotomy Approach
*Bernard M. Kramer, M.D., and Gordon McCoy, M.D., San Francisco* ..... 132

Congenital Choanal Atresia
*Robert G. MacLean, M.D., Los Gatos, Calif., and William Hammock, M.D., San Francisco* ..... 137


### CLINICAL NOTES, NEW INSTRUMENTS AND TECHNIQUES


The Combination of Antimicrobials and a Corticoid (Florotic) for Treatment of Otitis Externa
*Sol A. Goldberg, M.D., Philadelphia* ..... 139


### REGULAR DEPARTMENTS


Abstracts from Current Literature ..... 143

Books ..... 149

News and Comment ..... 150

Directory of Otolaryngological Societies ..... 151



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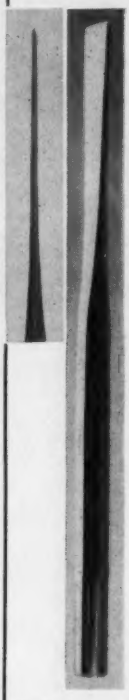

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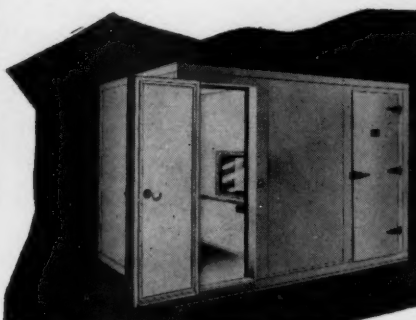

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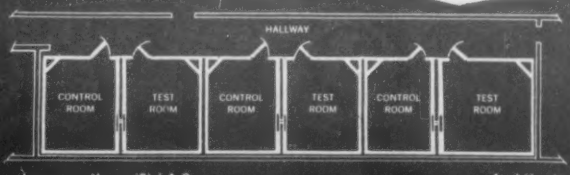


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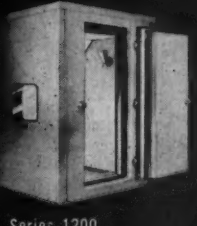

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A.M.A. ARCHIVES OF
OTOLARYNGOLOGY

# Surgery for Bilateral Bony Atresia of the Posterior Nares in the Newborn

HENRY H. BEINFIELD, M.D., Brooklyn

Obstetricians, anesthetists, and pediatricians are beginning to recognize and diagnose more frequently now than heretofore the presence of a bilateral atresia of the posterior nares as the cause of suffocation in the newborn. When these cases were referred to the otolaryngologist to create immediately a nasal airway, the difficulty encountered in an attempt to do so usually ended in failure. They were at a loss to know how to handle the case, with the result that the infant died. The fact that no definite standard surgical approach for its correction had been employed is the reason for this failure. The purpose of this paper is to describe a technique of intranasal approach which is simple, effective, and not destructive to the normal anatomy and promptly establishes a clear nasal airway within the first 24 hours after birth.

My experience is based on three cases, over a three-year period, which were saved from suffocation at birth.[1] Although this is not a very large number, it nevertheless is significant to demonstrate what can be done under the circumstances. Since there are no available statistics at present, the incidence of atresia is not known, primarily because atresia of the posterior nares is seldom considered as a possible cause of death by suffocation. A listing of this condition should be made by our vital statistical agencies, if we are to be informed of its frequency.[2] Statistics furnished by the Health Department of the City of New York for the year 1951 showed that there were 162,755 live births classified under "postnatal suffocation and atelectasis"; 729 of them died during the year, and of these, 389, or about 53%, died under one day of age. How many might have been due to atresia of the posterior nares no one knows, because the posterior nares is never examined for atresia to make a record of this finding.

Many physicians are not familiar with the fact that if an infant cannot breathe through its nose, owing to the presence of a bilateral obstruction resulting from an atresia of the posterior choanae or nares, it normally will not open its mouth to breathe and, therefore, will suffocate. Sir St. Claire Thomson[3] stated, "It is normal for an infant to breathe only through its nose." Mouth breathing is never normal at any age. There is no reflex present to open the mouth, whether it be the adult or the infant. As a matter of fact, the newborn in its attempt at forced nasal breathing will reflexly close its mouth tighter, thereby shutting off its only source of air to maintain life. As a result it dies of suffocation. Opening the mouth is purely a voluntary action which the newborn do not have.

Submitted for publication Dec. 3, 1958.

From the Departments of Otolaryngology of the Prospect Heights and Long Island College Hospitals.

Many patients with bilateral atresia are known to have been operated on by various surgical procedures weeks, months, or even years after birth. These patients would never suffocate. They may have been mouth breathers to begin with or for some other reason were able to be kept alive until they developed mouth breathing. Such patients are the exception and not the rule. The majority of them die shortly after birth, with a postmortem diagnosis of congenital atelectasis, because the infant never did breathe to expand the lungs. Conversely, the pathologist should examine the nose for atresia of the posterior nares in every case of atelectasis or whenever no other cause of death could be found, if the incidence of atresia is to be determined. Morrow[4] reported results on three newborns treated by dilatation with esophageal bougies.

There is no reason why an adequate nasal airway cannot be established within the first 24 hours, thereby saving the lives of all of these infants. The longer one waits to create a clear nasal airway, the severer are the complications of anoxia.

## Anatomy

Atresia of the posterior nares is a congenital anomaly, situated between the hard and soft palate, completely closing the posterior nares. It may be membranous, completely or incompletely bony, and present on one or both sides.

The anomaly may be hereditary and associated with other facial defects or anomalies. In the completely bony atresia the nasal mucous membrane covers the bone anteriorly and the pharyngeal mucous membrane covers it posteriorly. Embryologically, the atresia results from failure of the buccopharyngeal membrane to open. In the incompletely bony atresia, the bony portion extends from the lateral nasal wall, while the remainder or membranous portion extends from it to the septum.

## Diagnosis

In all infants with asphyxia neonatorum, bilateral atresia of the posterior nares should be excluded first. The inability to pass a rubber catheter through the nose into the pharynx should lead one to suspect the presence of an atresia, or, when a dye in-

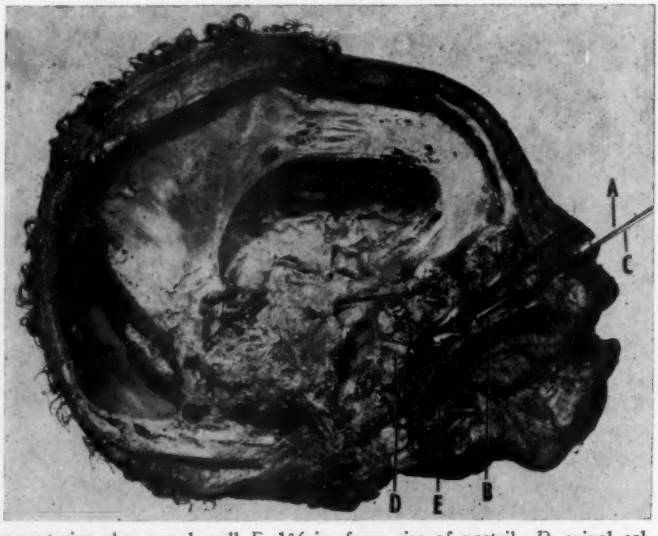



Fig. 1.—Saggital section of the head of a full-term fetus. Note the compactness of the structures of the nose and the relative smallness of the face, as compared to the size of the rest of the skull. The atlas and axis are in direct line with the floor of the nose. This is the danger area, which can easily be penetrated and the spinal canal entered, if the curette is passed beyond the 1¾ in. from the rim of the nostril. *A*, metal probe, showing marking at rim of nostril 1¼ in. from tip; other marking on probe measures 1¾ in. *B*, tip of probe in right nostril is at point where atresia is usually located. *C*, wooden applicator placed through left nostril, showing end of it at the posterior pharyngeal wall *E*, 1¾ in. from rim of nostril. *D*, spinal column showing axis and atlas (danger area). (Photograph of specimen obtained through courtesy of Dr. George B. Talbert, Assistant Professor, Department of Anatomy, State University of New York College of Medicine at New York.)

stilled in the nose fails to pass to the nasopharynx, atresia likewise must be suspected. With a metal probe one should measure the distance from the rim of the nostril to the point of resistance in the nose. If this distance measures 1¼ in. or less, a diagnosis of atresia can be reasonably made. The diagnosis can be confirmed by iodized oil (Lipiodal) x-ray studies, preferably, however, after the nasal mucous membrane has been shrunk with a vasoconstrictor for greater contrast.

Is the atresia membranous or bony? It does not make a great deal of difference which it is. Although it is not possible to determine by probing or x-ray studies whether the atresia is bony or membranous, the nature of it can be determined by using a No. 11 Bard Parker blade on a long No. 7 handle. After the knife is introduced through the nose to the obstruction, an effort is made to penetrate the atresia. If, after a moderate degree of pressure is exerted, the blade does not go through the atresia but a grating sensation of bone is felt, then it can be assumed that the atresia is bony and not membranous.

### Surgical Treatment

The most important factor in preventing suffocation of the newborn is to create immediately an adequate airway.[5] The simplest and quickest way to do this is to open the infant's mouth and keep it open with an anesthetist's infant-size airway. In this manner a sufficient though not entirely adequate supply of air is obtained until a clear nasal airway can be established. This is an emergency life-saving procedure. The airway should be retained in the mouth until the operation is completed, after which is can be removed. With the infant mummified, the operative procedure is carried out in the nursery, under local anesthesia, with use of a topical application of equal parts of 1% tetracaine (Pontocaine) and epinephrine (Suprarennin) to the nasal mucous membrane. A No. 2 Lempert type mastoid curette is used to remove the bony atresia. A piece of adhesive is first wrapped around the shank of the curette 1¼ in. from the tip (Fig. 3). The adhesive tape marks the distance from the atresia to the rim of the nostril and serves as a guide to note the progress of the curette passing through the bony atresia. The curette is then inserted into the nose up to the atresia. Beginning at the floor of the nose, with firm pressure exerted against the obstruction, the curette is rotated from side to side until the bone is perforated (Fig. 4). The nasal mucous

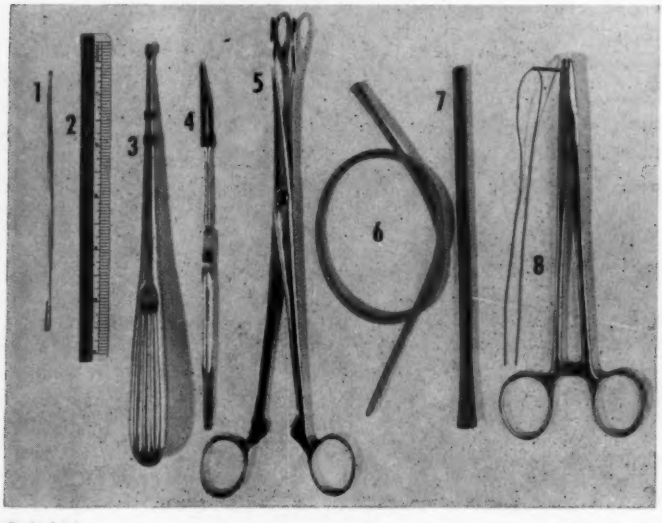



Fig. 2. — Armamentarium: *1*, metal probe; *2*, 6 in. ruler; *3*, No. 2 Lempert type mastoid curette, with adhesive tape wrapped around shank 1¼ and 1¾ in. from tip (Instead of the adhesive tape, a cut in the shank at these distances is now made in my own curette and probe.); *4*, No. 11 Bard Parker knife, with adhesive tape wrapped around the shank of the handle 1¼ in. from tip of blade; *5*, sponge stick for removal of catheter from the mouth; *6*, No. 12 F. rubber catheter; *7*, No. 18 F. polyvinyl tubing; *8*, needle holder, with needle threaded with black silk.

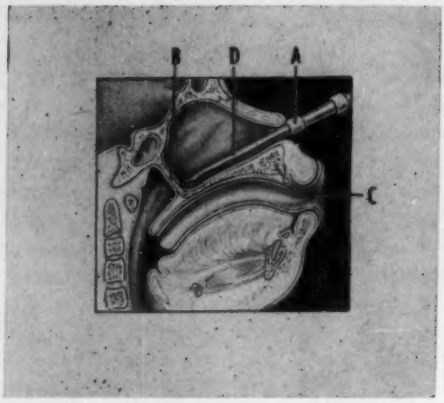



Figure 3

Fig. 3.—*A*, adhesive tape, wrapped around the shank 1¾ in. from tip of curette. *B*, bony atresia of the posterior nares. *C*, airway in mouth. *D*, curette placed on floor of nose against bony atresia.

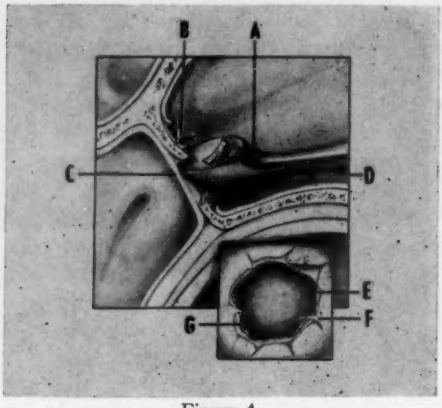
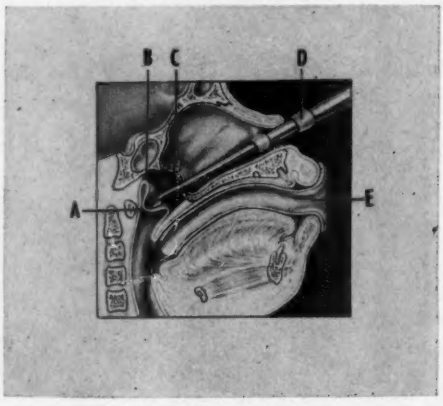



Figure 4

Fig. 4.—*A*, curette removing bony portion of atresia together with nasal mucous membrane, showing pharyngeal mucous membrane, *C*, intact. *B*, shreds of nasal mucous membrane. *C*, pharyngeal mucous membrane. *D*, removed spicules of bone on floor of nose. Insert: *E*, bony atresia almost completely removed. *F*, shreds of nasal mucous membrane in front of the atresia. *G*, intact pharyngeal mucous membrane.

membrane in front of the atresia must be sacrificed with the bone. All of this manipulation is done through the sense of touch. The bony perforation is then enlarged to a point at which the curette is felt to be on a level with the bone of the floor of the nose, septum, roof of the posterior nares, and lateral nasal wall. Most of the bony portion of the atresia can then be assumed to be removed. The bone is actually curetted off the pharyngeal mucous membrane, although not completely and usually without its being perforated. This pharyngeal mucous membrane which covered the posterior surface of the bony atresia will therefore still be intact, thus converting the bony atresia into a membranous atresia. The pharyngeal mucous membrane is actually stripped away from its other bony attachments by the pressure of the curette against it while the bone is being curetted off and pushed backward intact in a tent-like fashion against the posterior pharyngeal wall (Fig. 5). The distance from the rim of the nostril will now measure about 1¾ in., but as yet there is no airway into the pharynx. If the atresia were membranous to begin with, it also would be treated in the same manner from this point on. Any bony spicules in the nose are then removed by irrigation and suction. The pharyngeal mucous membrane is somewhat fibrous and rather resistant and must be incised to create an opening. The success of the operation depends on such an opening being made in the pharyngeal mucous membrane which still closes the posterior nares. This is the most important step in the technique. That

Fig. 5.—*A*, pharyngeal mucous membrane pushed against the posterior pharyngeal wall after being stripped away from its normal bony attachments (*B*). *B*, exposed bone of the lateral pharyngeal wall. *C*, bony atresia completely removed. *D*, adhesive tape on shank at rim of nostril measures 1¾ in. from tip of curette. *E*, airway still in mouth.



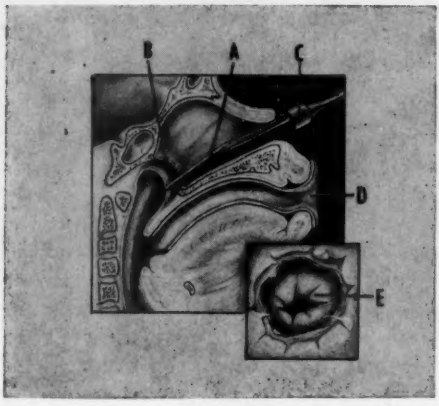



Figure 6

Fig. 6.—*A*, No. 11 Bard Parker blade cutting through the pharyngeal mucous membrane near floor of nose. *B*, bony atresia completely removed. *C*, adhesive tape wrapped around handle of Bard Parker blade 1¼ in. from tip of blade. *D*, airway still in mouth. Insert: *E*, stellate incisions through pharyngeal mucous membrane.

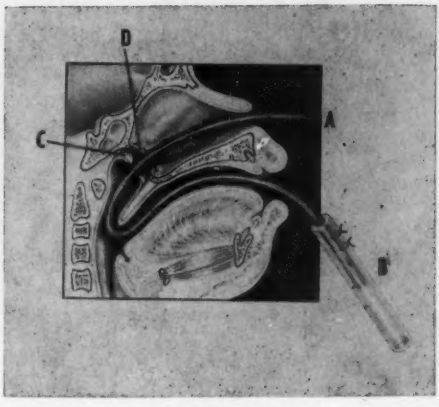



Figure 7

Fig. 7.—*A*, No. 12 catheter passed through nose and brought out of mouth. *B*, tip of catheter inserted into lumen of a piece of No. 18 F. polyvinyl tubing about 1¾ in. long, with two silk sutures passed through catheter and tubing tied firmly near end of tubing. Note airway in the mouth has been removed before catheter is passed. *C*, incised pharyngeal mucous membrane, with No. 12 catheter passed through opening in it. *D*, bony atresia completely removed.

portion of the pharyngeal mucous membrane which is near the floor of the nose is farthest from the posterior pharyngeal wall. It, therefore, is simpler and safer to incise the pharyngeal mucous membrane at this location and at the same time to avoid the danger of injuring the posterior pharyngeal wall. With a No. 11 Bard Parker blade on a long No. 7 handle passed into the nose along the floor over a grooved director—or it can be done without it—with the cutting edge directed upward and kept close to the septum until it reaches the pharyngeal mucous membrane, the membrane is then incised (Fig. 6). An attempt should be made to enlarge the incision in a stellate fashion. The airway in the mouth is removed after the pharyngeal mucous membrane has been incised. The incision through the pharyngeal mucous membrane finally creates an opening into the pharynx and a clear nasal airway. This opening should be large enough at least to permit the passage of a No. 12 rubber catheter through it into the pharynx; it is then brought out of the mouth when grasped with a sponge stick.

A piece of polyvinyl tubing * is now fastened to the end of the catheter. The tip of the No. 12 catheter is inserted into the lumen of the polyvinyl tubing, and both are sutured together with heavy silk. The catheter and tubing are then in the same axis (Fig. 7). The width of the tubing used should be the same size as the opening of the anterior nares, a piece of a No. 18 F. tubing is approximately correct, and its length should measure a little less than 1¾ in. As the catheter is drawn out of the nose from the mouth with the tubing trailing, care should be exercised to assist the tubing over the soft palate with the finger. Since the incision in the pharyngeal mucous membrane is not large enough to accept the No. 18 F. tube, the catheter acts as a guide, while being pulled out of the nose, to direct the tubing into the nose through the opening made in the pharyngeal mucous membrane. Considerable force is necessary to bring the tubing from the nasopharynx through the inadequate pharyngeal mucous membrane opening. The opening in the

* Bardic, manufactured by C. R. Bard, Inc., Summit, N. J.

Fig. 8.—*A*, pharyngeal mucous membrane brought into nose, covering newly created bare bony rim and uniting with remnants of nasal mucous membrane. *B*, the polyvinyl tubing in position caught under tip of nose in front.

pharyngeal mucous membrane is therefore stretched and actually torn as the tubing is forcibly pulled into position in the nose. Bringing the tube into the nose by way of the nasopharynx causes the pharyngeal mucous membrane to be drawn into the nose. This enables the pharyngeal membrane to heal together with the torn remnants of the nasal mucous membrane in front, thereby covering the newly created bare bony rim (Fig. 8). The catheter is removed from the tubing, as the sutures are cut, when the tip is visualized at the rim of the nostril. The tubing is held in place by being hooked under the tip of the nose. The infant will now be breathing freely and comfortably through the nasal tubes, with the mouth closed. There is very little bleeding during the operation, and the entire procedure on one side of the nose requires about 10 minutes. One should never violate the distance of 1¾ in. from the rim of the nostril. If one extends beyond this point with the curette it may prove hazardous. Should the curette be inserted deeper than 1¾ in., there is the great danger of penetrating the spinal canal between the atlas and axis, with the end-result that a hydrocephalous will develop.

## Postoperative Management

The nasal tubes must be suctioned as frequently as necessary to keep them patent, free of blood and mucus. If the tubes are caught under the tip of the nose they will not fall out. The feeding program is carried on as usual for the newborn. How long the nasal tubes should remain in place before they can be permanently removed is not yet definitely determined. An arbitary time of four weeks is recommended. Suction of the nose may be necessary even after the tubes are removed. One should guard against the possible closure of the opening by passing the removed tube through it every few days to determine its patency. Should signs of closure occur, the original tubes should be replaced for another four weeks. This procedure should be repeated as often as necessary until a permanent opening is finally established. One should never wait for complete closure to do this, because it becomes very difficult to reinsert the tubes. Obviously, the healing changes which take place from the original surgery account for the difficulty.

## Comment and Conclusions

The technique described is new, requiring further study and experience to determine its effectiveness. Why the newly created opening in the posterior nares has a tendency to close remains an unsolved problem. It is possible that the bony fragments clinging to the nasal and pharyngeal mucous membrane may be responsible for the closure. In the meantime, the life of an infant can be saved.

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## REFERENCES

1. Beinfield, H. H.: Congenital Bilateral Bony Atresia of the Posterior Nares in a One-Month Premature Infant Who Survived: Experiences with a Case, J. Pediat. 45:679-687 (Dec.) 1954.

2. Beinfield, H. H.: The Unsolved Problem of Infant Suffocation, New York J. Med. 57:3160-3161 (Oct. 1) 1957.

3. Thomson, St. C., and Negus, V. H.: Diseases of Nose and Throat, New York, Appleton-Century-Crofts, Inc., 1937, p. 70.

4. Morrow, R. C.: Bilateral Congenital Choanal Atresia: A Report of 3 Cases Corrected Surgically in the Newborn, Ann. Otol. Rhin. & Laryng. 66: 135-138 (March) 1957.

5. Beinfield, H. H.: Atresia of the Posterior Nares in the Infant: Relationship to Suffocation and Its Prevention, Eye, Ear, Nose & Throat Month. 34:575-579 (Sept.) 1955.

# Surgical Hearing Rehabilitation of the Chronic Suppurating Middle Ear

L. GARCÍA-IBAÑEZ, M.D., Barcelona, Spain

Since 1946, when I initiated my practice in otosclerosis surgery, I have felt confident that the new technique brought about by fenestration would substantially improve functional prognosis in the surgery of chronic middle ear infections.

In February, 1950, I published my first work [1] in this field, on a type of operation which I called "semiconservative," an improvement of Ramadier's antroattical emptying procedure and similar to the "modified radical operation."

In semiconservative operation middle ear structures are much more respected and preserved than in radical procedure. In a consecutive series of operations an average postoperative hearing level of 43.9 db. was obtained (Fig. 1). However, the attainment of complete social level was not possible in most cases, owing to the fact that the physical features of a middle ear treated by this procedure were not favorable for a correct transmission and transformation of sound. Both labyrinthine windows, oval and round, were situated behind the same air cushion of the middle cavity and they received the sound waves with no difference in pressure or intensity and with very scarce difference in phase; as a result sound stimuli reaching the inside of the labyrinth, through both windows, became mutually neutralized in great part (Fig. 2).

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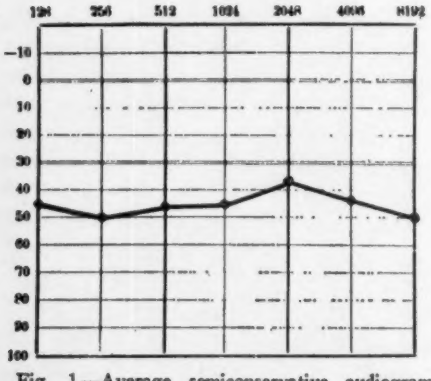



Fig. 1.—Average semiconservative audiogram (43.9 db.)

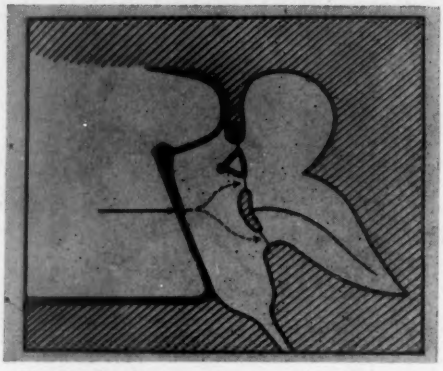


Fig. 2.—Semiconservative operation. The round and oval windows receive the sound wave without a significant change in pressure and with minimal phase difference.

Nevertheless, in several cases which were reported at the 1953 International Congress in Amsterdam,[2] outstanding social level rehabilitations had been obtained, without there being, up to that moment, a physical explanation which would make sufficiently clear the reasons for such outstanding improvements. There were Zöllner's suggestions about the "columella effect" that gave us the key to what had happened. During a semiconservative operation the tympanic membrane had been accidentally separated from the posterior portion of the annulus tympanicus in a greater extension than was customary, and, being free of its habitual

tension, it had fallen on the head of the stapes; as a consequence, and on account of a mechanism which I shall explain later on, the sound pressure over the oval window became substantially strengthened. The middle ear had been columellized *by chance,* and the stapes—as in the columella mechanism of birds—had established a direct connection between the tympanum and the labyrinth.

Thenceforth we started to perform columellizations, *on purpose,* by "tympanostapedopexy" when the tympanic membrane was intact, or by means of a full-thickness skin graft when the tympanic remnants were insufficient. By these procedures we had already been obtaining, repeatedly, postoperative levels of 30 db. or better, that is to say, complete social rehabilitation. The results obtained were reported to the Paris International Congress of Audiology [3] held in January, 1955, and to the Spanish Otorhinolaryngological Society in October of the same year.[4]

However, a long time before, in 1950 and 1951, we had been obtaining similar results exceeding practical hearing level, through the combination of our semiconservative procedure with utilization of spontaneous cholesteatomatous fistulae present, adequately prepared (Fig. 10), or by means of complementing the above-mentioned preliminary operation with a further fenestration. These trial operations, which had been started in July, 1950, were first reported to the Andalusian Otorhinolaryngological Society [5] in June, 1951, and later on amplified in *Acta oto-rino-laring. ibero-am.*[6] in 1952.

For years in Spain we have stuck to this type of operation (semiconservative tympanomastoidectomy and fenestration in two steps) against those tendencies backing up radical mastoidectomy and fenestration in a single step.[7]

The following paragraph, quoted from a communication [8] of the "Jornadas Médicas Aragonesas," May, 1954, clearly illustrates our position to this respect:

"With the preservation of the tympanic 'pars tensa' and other middle ear structures, it is possible to secure behind the air cushion of the tympanic cavity an unaltered round window and Eustachian tube, plus ideal conditions for the transmission of sound waves to both labyrinthine windows with a difference in phase similar to the one found in normal ear."

These concepts developed by us since 1950 are at present generally accepted and applied in surgical functional rehabilitation of the chronic middle suppurating ear with a fixed stapes. Their physical principles are identical with those which form the basis of Group V in Wullstein's classification.[9]

Antolí-Candela [10-13] in a series of works devoted to audiosurgery in otorrhea has made an important contribution in the field, which often coincides with my own ideas. A result of this coincidence was the work which we jointly presented in 1956 at the meeting of the Spanish Society of Otorhinolaryngology.[14]

Particular interest arose from the works presented by Zöllner [15] and Wullstein [16] at the International Congress in Amsterdam.

In Italy as well, the works prepared by Pietrantoni, Bocca, and Agazzi, of the Milanese school, and the joint work presented by Bozzi and Carnevale-Ricci [18] at the Italian Congress held in 1955 are examples of the Italian contribution to the development of this type of surgery.

New contributions made by some of the European authors referred to above, including a personal communication of mine, may be found in the Abstracts of the Sixth International Congress of Otolaryngology [19] held in Washington in May, 1957, together with those presented by Juers, Goto Shiji, Verhoeven, Niho Miyoji, and Yasuda Kazuhide.

In this work I shall endeavor to present my present experience in functional microsurgery of otorrhea based on a total of 244 operations. It includes others' ideas and techniques, especially those disseminated by the German authors as reported at the International Congress held at Amsterdam in 1953, as well as some ideas and systems personally developed before 1950.

In order that the sound waves may pass, without a significant loss in energy, from the atmospheric air to the labyrinthine fluids, of different density and elasticity from those of the former, the transformer mechanism of the middle ear is indispensable.

On one hand, the tympano-ossicular system reinforces the sound pressure—by concentration of the energy gathered by the great tympanic screen—on to the small surface of the footplate of the stapes in the oval window. On the other hand, the air cushion existing in the tympanic cavity, interposed to the round window, lessens, in some way, the sound waves reaching through this way the "scala tympani" ("sound protection of the round window," according to Wullstein). Thus, the transformer mechanism formed by the middle ear increases the sound pressure which operates on the labyrinthine fluids and prevents undesirable interferences between the sound waves coming in through both windows.

Figure 3 is a graphic illustration of the surface relation ("hydraulic relation") existing between the tympanic membrane and the footplate of the stapes, 17 times smaller. According to Wullstein, a gain of 25 db. should correspond to this surface relation.

Figure 4 represents the ossicular chain mechanism. As can be seen, the relation existing between the motion of the handle of the malleus and the descending process of the incus is 1.3:1, which would be equivalent, also according to Wullstein, to a small gain of 2.5 db.

Comparative examination of Figures 3 and 4 clearly shows that in the transformer

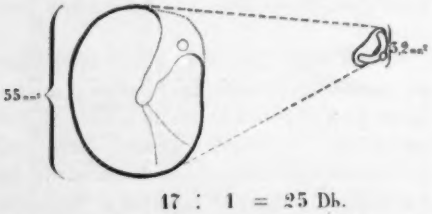



Fig. 3.—The hydraulic relation, or relation between the tympanic membrane and the footplate of the stapes, is the most important element in the reinforcement of sound waves to the labyrinth.

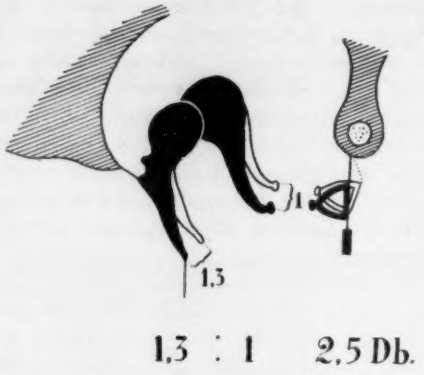



Fig. 4.—The movement of the ossicular chain is a nonimportant factor in sound transformation.

function of the middle ear the so-called hydraulic relation plays the most important part, while the movement of the ossicles is quite secondary; this is of utmost importance in determining the type of tympanoplastic surgery best suiting a given case of chronic middle suppurating ear.

As a general rule, all anatomical structures taking part in the transformer mechanism of the middle ear should be preserved to a maximum; however, to restore good hydraulic relation, either by preservation or by reconstruction of the tympanic membrane, which is technically possible in many instances, is more interesting by far than to preserve or reconstruct the ossicular chain when it is interrupted, blocked, or destroyed by the pathological process—a task much more difficult or absolutely unrealizable in a great number of cases.

## Basic Procedures for Tympanoplastic Surgery

The pathological lesions that suppurating otitis refers to the delicate structures of the transformer mechanism of the middle ear vary in an extraordinary way. Therefore, the task of eliminating those lesions by surgery, preserving all utilizable elements, and restoring a new system of sound conveyance and transformation, cannot be adjusted to a general procedure. Each patient presents a different problem which must be

specifically solved. Nevertheless, the different surgical procedures can be schematically grouped in a few general basic systems, election of which will depend mainly on the condition of the tympanic membrane and ossicular chain, the mobility of the windows, the patency of the Eustachian tube, and the degree and nature of the pathological process.

In a joint meeting of the Otorhinolaryngological Societies of Bordeaux and Barcelona[20] and also in the above-mentioned work of 1956, I suggested five fundamental groups in tympanoplastic surgery. At the present time I consider Group V of such classification (radical operation and fenestration) as an exceptional resource and I group the different tympanoplastic procedures in four basic systems:

I. Complete reconstruction of the sound transformer mechanism
II. Columellization of the middle ear
III. Sound protection of the round window
IV. Sound protection of the round window associated with fenestration or utilization of preformed pathological fistulae

Preoperative clinical examination of the patient with the Hallpike otomicroscope, especially direct audiometric evaluation using Zöllner's probe and careful study of Eustachian tube patency, together with radiological data, provides us with information to deduce or guess the condition of the different structures of the middle ear and enables us to plan, beforehand, one of the four basic procedures above classified.

However, the final decision and procedure are determined during the operation itself by direct observation, under higher magnification, of the condition and functional capacity of the different elements which constitute the middle ear transformer mechanism (tympanic membrane, ossicular chain, labyrinthine windows, Eustachian tube).

In the early beginning we used exclusively the Zeiss glasses ($\times$ 2.5) and the Shambaugh microscope ($\times$ 10). Since 1954 we have added to our equipment the Zeiss surgical microscope fitted with magnifications varying between 6 and 40. Although for the cutting of the labyrinthine window in fenestration, both microscopes have proved equally valuable, in functional surgery of otorrhea where the scope is wider and we find a greater variety of exposures, the Zeiss surgical microscope offers decisive advantages. In order to secure satisfactory magnification a device to place the patient's head in the position best suiting every surgical step is necessary. The headrest shown in Figure 5, which was described in a previous paper,[21] has been a valuable help to me.

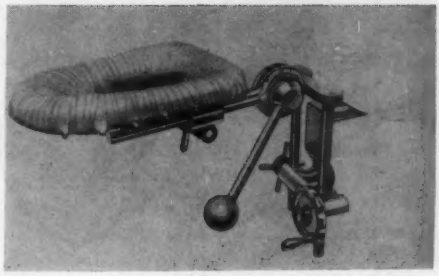


Fig. 5.—Headrest developed by the author. Rotatory movements along the longitudinal axis, as well as the transverse axis, and vertical movements of the head are possible.

*I. Complete Reconstruction of the Sound Transformer Mechanism (Wullstein).*—This is so far the most perfect procedure. Through it we restore as much the transforming function of sound pressure on the oval window (hydraulic relation and ossicular mechanism) as the sound protection of the round window. Its indications are extremely limited and it can be applied only when the ossicular chain is intact.

In Figure 6, *A*, there is shown a cut of the lesions and the tympanic picture in a typical case. In *B* there is shown the technical solution of the same case, where a full-thickness skin graft is used and the osseous bridge on the ossicular mass is preserved. In *C* there are shown pre- and postoperative audiograms of this case.

In *D* there are shown per-cent results obtained in 27 cases operated on by this procedure. In 14 cases (51.85%) 15 db. or a better level was obtained; in 9 cases (33.33%) the level obtained was between 15 and 30 db.

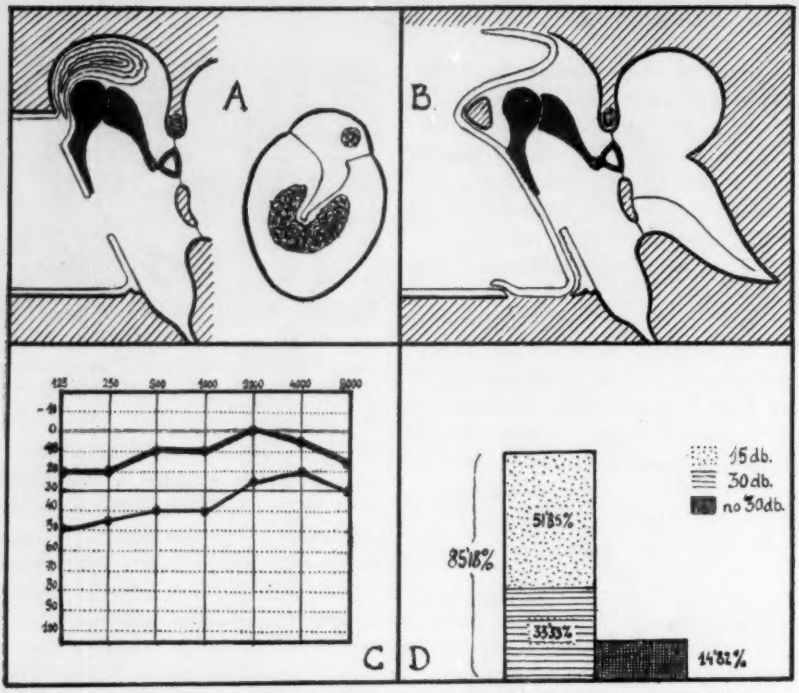



Fig. 6.—Total reconstruction (Wullstein). *A*, *B*, *C*, pathology, surgical reconstruction, and audiometric evaluation in a typical case. *D*, results in 27 cases.

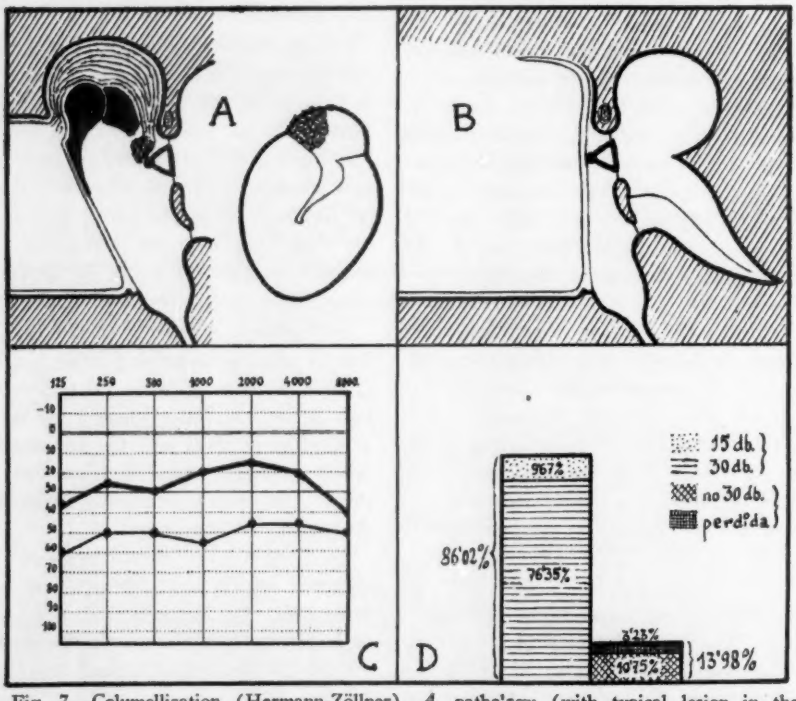



Fig. 7.—Columellization (Hermann-Zöllner). *A*, pathology (with typical lesion in the process of incus). *B*, reconstruction by tympanostapediopexy. *C*, audiometric evaluation in this representative case. *D*, results in 93 cases.

To summarize, 23 (85.18%) good results were obtained, among which are included some cases showing a postoperative loss. It must be kept in mind that if the ossicular chain is intact the preoperative hearing level is extremely good in the vast majority of cases. Accordingly, we have classified as a good result every case in which practical hearing (social level) was reached, no matter whether the postoperative hearing showed gain or loss.

On the other hand, four cases (14.82%) not reaching 30 db. were considered as failures. One of these cases showed a gain exceeding 10 db., but as it did not reach social level it was considered a technical failure.

*II. Columellization of the Middle Ear (Hermann-Zöllner).*—When the ossicular chain is interrupted, but an intact, mobile, functional stapes may be preserved, the hydraulic relation (surface relation between the tympanum and the foot-plate of the stapes) can be still utilized although the ossicular mechanism is lost.

Sometimes the first visual impression is that the ossicular chain is intact, but upon moving the malleus with a probe it is realized that no movement is transmitted to the stapes. Quite frequently we find that an osteitis has developed in the lower extremity of the descending process of the incus. At this point a fibrous connection replacing the bone is occasionally found, which, naturally, lacks sound transmission capacity.

If the "pars tensa" of the eardrum is preserved, the posterior portion of the "annulus" is separated and the membrane is left resting against the stapedial "capitulum." This is the type of operation which we have called *"columellization by tympanostapedopexy"* (retroposition of the tympanic membrane according to Wullstein or myringostapedopexy of Juers) (Fig. 7, *B*).

When the portion which is left of the tympanic membrane is insufficient to connect directly with the stapes, the defective ascending portion is complemented with a full-thickness skin graft—*columellization by complementary tympanoplasty.*

If the tympanic membrane is totally absent, a full-thickness skin graft is used to replace it—*columellization by complete tympanoplasty.*

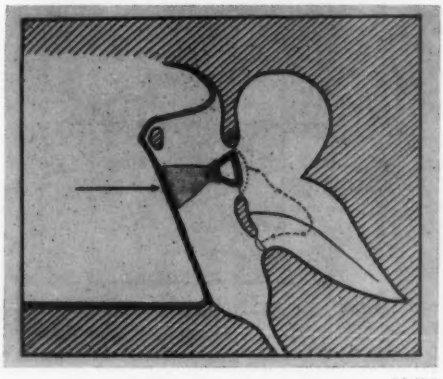
Whenever a skin graft is used, the epithelium of the existing remnants of the tympanum should be previously removed and, occasionally, even the epithelium of the surrounding portions of the external ear canal, so as to provide a nourishing bed for the graft.

If the lesions have destroyed the entire chain, and only the footplate of the stapes remains intact and mobile, an *artificial columella* may be used, but I, in such cases, prefer not to use sound transformation on the oval window, but rather to reconstruct only a small hypotympanic cavity for the sound protection of the round window.

In special cases in which the bridge can be preserved but the stapes, intact, is too short to connect with the tympanum or neotympanum, the solution can be found in the manner represented in Figure 8, by adding a complementary acrylic semicolumella, that is, creating a true columella with a double plate or *columella veritas.*

In Figure 7, *A*, there are shown the otoscopic picture and a cut of the lesion in a typical case with the chain interrupted in the descending process of the incus. In *B* we can observe the technical solution of the same case (columellization by tympanostapedopexy) and in *C*, pre- and postopera-

Fig. 8.—Complementary plastic semicolumella connecting tympanic membrane to stapes (columella veritas).



tive audiograms showing an important gain. In *D* the results obtained in 93 columellizations of different types are expressed in percentages.

In this group there are classified as successful the 80 cases (86.02%) in which a postoperative level of 30 db. or more was reached. Of these cases, 71 (76.35%) were between 15 and 30 db. and only in 9 cases (9.72%) was a 15 db. level reached or improved.

Among the 13 failures (13.98%) there are included all those cases in which a 30 db. level was not reached. In 10 cases (10.75%) no loss was apparent, but in 3 (3.23%) hearing not only did not reach practical level but it descended below the preoperative one.

*III. Sound Protection of the Round Window (Moritz).*—In this system only a pneumatic space over the round window, which is ventilated by the Eustachian tube, is reconstructed (hypotympanic space of Zöllner or small case). The sound waves are allowed to reach the oval window directly without previous transformation of the sound pressure. This technique is applied especially in those cases where only the mobile footplate of the stapes is left.

Sometimes this small hypotympanic cavity can be formed out of the tympanum itself (tympanopromontopexy). But when the remnants of the membrane are not large enough, a full-thickness skin graft is required.

In Figure 9, *A*, the otoscopic picture and a cut of the lesions in a typical case are presented. In *B* there appears a small hypotympanic space on the round window connected to the Eustachian tube (formed in this case by a tympanopromontopexy). The oval window, with the footplate, is left directly exposed to the sound waves and above it the epithelization of the cavity is completed with a full-thickness skin graft.

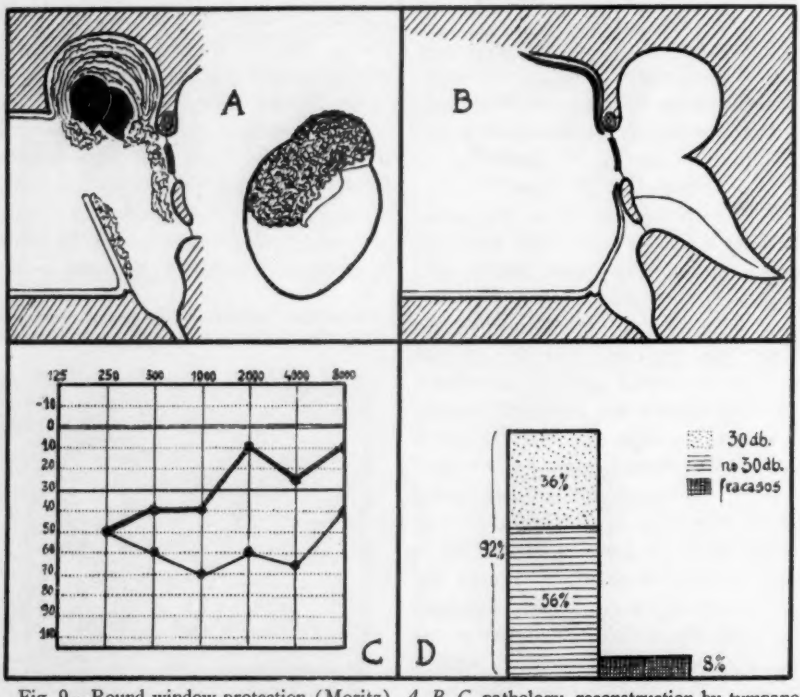



Fig. 9.—Round window protection (Moritz). *A, B, C,* pathology, reconstruction by tympanopromonotopexy, and audiometric chart in a typical case. *D,* results in 75 cases.

In *C* pre- and postoperative audiograms exhibiting considerable gain are shown.

In the cases where this type of reconstruction is indicated the preoperative level is usually low and to obtain considerable gains by this simple operation becomes extremely easy. However, owing to this very reason there is much less probability of attaining a practical level than in the two surgical procedures previously described. This is clearly shown in Graph *D* of Figure 9, where the results obtained in 75 cases are represented in percentages.

Only in 27 cases (36%) was the practical 30 db. level attained. But there are also included as successful 42 cases (56%) in which, although no practical hearing level was reached, a gain of 15 db. or more was obtained.

To summarize, 69 (92%) good results were obtained. In the other six cases (8%) either no gain was achieved or the gains were totally insignificant. All these cases were considered as failures.

*IV. Sound Protection of the Round Window Associated with Fenestration or Utilization of Preformed Pathological Fistulae. (García-Ibañez).*—In order to apply any one of the three basic procedures above described there must exist or be restored by surgery a good Eustachian tube ventilation, as well as mobility of both labyrinthine windows.

To find a round window absolutely blocked is very rare (we have never found one), but at times the oval window appears blocked, owing either to a coincident otosclerosis or to a strong fibrosis. In these cases the solution becomes more complex.

In some cases with a fixed stapes due to otosclerosis we have managed to mobilize it and have performed a columellization in a single surgical step, but if the otosclerotic blockade cannot be reduced, or there exists a strong fibrosis of the annular ligament and no passive movement on the round window can be obtained on putting pressure against the footplate of the stapes, the first surgical step should be completed by the creation of a pneumatic cavity at the round window, either by a semiconservative operation (modified radical operation) or simply by restoring a small hypotympanic cavity.

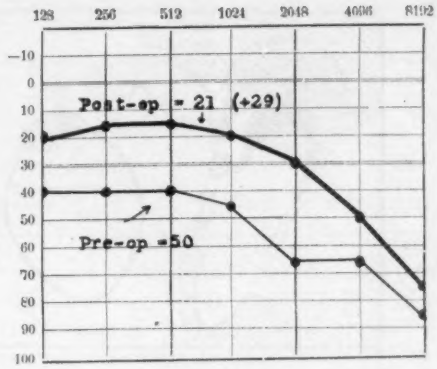



Fig. 10.—Pre- and postoperative audiogram of the second case operated on by conservative procedure preserving existing fistula created by cholesteatoma (Oct. 31, 1950).

Sometimes the functional finality may be obtained in a single surgical step by making use of the occasional presence of a cholesteatomatous fistula in the horizontal canal. In such a case, in removing the cholesteatomatous matrix the small portion covering the fistula and a few millimeters around it must be preserved, also leaving its adhesions to the perifistular bone. The audiogram of Figure 10 shows the first case in which we operated by this technique in July, 1950, and in which at present the fistula is kept open and the original gain in hearing is preserved.

In the cases with a blocked oval window, in which no coexisting, pathological, labyrinthine fistula is present, it is necessary—after having made sure of the sound protection of the round window by means of either a small or a large case, made in a first surgical step—to perform a typical fenestration in a second, separate step.

If any doubt is left with regard to the degree of immobility of the oval window, it will be advisable to make sure of its blockage in the first step by cementing the window with a paste made of melted Horsley wax and bone dust; we have been using

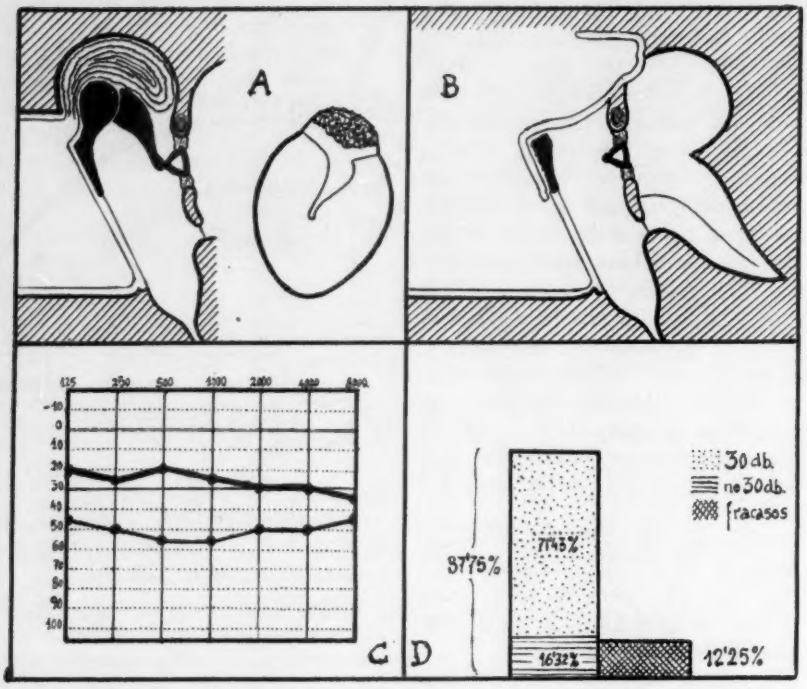



Fig. 11.—Protection of round window and fenestration or preservation of pathological fistula (García-Ibañez). *A*, pathology, with fixed stapes. *B*, semiconservative surgery and fenestration. *C*, pre-postaudiogram for the case. *D*, results in 49 cases.

these materials for several years for occlusion of the Eustachian tube, at the time when making sure such occlusion was considered a basic principle in radical ear surgery.[22] As described above, the oval window niche is filled with the osteogenetic wax, after careful cleaning of the surrounding area.

Operations were performed in 49 cases according to different variations of this last basic procedure.

In Figure 11, *A*, the otoscopic picture and a cut of the lesions in a typical case with a fixed stapes are shown. In *B* the same case is schematically shown, solved by means of a semiconservative operation and a further fenestration. In *C* the audiometric gain is shown, and in *D* successful results and failures in the 49 cases are recorded.

There were 43 cases (87.05%) in which gains of 10 db. or more were obtained and which were classified as successful, but in only 35 of them (71.43%) was a practical level reached. In the remaining eight cases (16.32%) postoperative level was between 30 and 40 db.

In six cases (12.25%) either no significant gain was obtained or the 40 db. level was not reached, these cases being considered as failures.

In Table 1 total favorable results are shown. In Table 2 there are shown those cases reaching social level, and in Table 3

TABLE 1.—*Functional Microsurgery in the Chronic Middle Ear: Results in 244 Cases*

| Type of Operation | Cases | Success | % |
|---|---|---|---|
| Total reconstruction | 27 | 23 | 85.18 |
| Columellization | 93 | 80 | 86.02 |
| Round window protection | 75 | 69 | 92 |
| Round window protection and fenestration | 49 | 43 | 87.75 |
| Total | 244 | 215 | 88.11 |

TABLE 2.—*Functional Microsurgery in the Chronic Middle Ear: Recuperation to Practical Hearing in 244 Cases*

| Type of Operation | Cases | 30 Db. or Better | % |
|---|---|---|---|
| Total reconstruction | 27 | 23 | 85.18 |
| Columellization | 93 | 80 | 86.02 |
| Round window protection | 75 | 27 | 36.40 |
| Round window protection and fenestration | 49 | 35 | 71.43 |
| Total | 244 | 165 | 68 |

TABLE 3.—*Functional Microsurgery in the Chronic Middle Ear: Recuperation to 15 Db. or Better in 120 Cases*

| Type of Operation | Cases | 15 Db. or Better | % |
|---|---|---|---|
| Total reconstruction | 27 | 14 | 51.85 |
| Columellization | 93 | 9 | 9.72 |
| Total | 120 | 23 | 19.17 |

those which reached 15 db. among the 120 in which, owing to the type of operation performed (complete reconstruction or columellization) so high a level might be expected.

When the Eustachian tube is blocked and its patency cannot be obtained during the operation, the situation is not favorable for tympanoplastic surgery. However, if both labyrinthine windows are patent, an attempt can be made to improve the difference in phase between them by means of Hughson's [23] aponeurotic graft or Tato's [24] fat graft. In favorable cases variation in phase can also be obtained by the simple trick of placing a classic petrolatum-impregnated cotton plug against the round window niche. But all these procedures must be considered as forced, imperfect solutions for exceptional cases.

If, besides irreducible Eustachian tube obstruction, blockage of the oval window also exists, we are, in my judgment, faced with the only type of case which fully justifies a fenestration in a patient who has had a radical operation. But, even so, this should be left for a further, separate step and only in the case of coexistence of an irreducible deafness in the opposite middle ear. Also in this case the minor operations of Hughson and Tato, or application of petrolatum-impregnated cotton, may prove complementary resources of relative usefulness.

## Summary

Our experience and results in tympanoplastic microsurgery of the chronic, middle, suppurating ear have been presented.

In part, we have developed ideas and procedures started by us in 1950. We refer to the combination of a semiconservative procedure (modified radical operation) associated with a fenestration or to the preservation and utilization of preformed pathological fistulae.

A personal achievement also is the type of columellization that we have called "columella veritas."

For the rest of the reconstructive procedures we have followed the ideas and techniques suggested by other authors, particularly Wullstein, Moritz, and Zöllner.

In a series of 244 operations, satisfactory results have been obtained in 215 (88.11%).

There were 165 cases (68%) which reached 30 db. social level.

Among the 120 cases in which from the type of operation performed (total reconstruction or columellization) high postoperative level might be expected, 23 of them (19.17%) reached 15 db. level or better. Another 80 of them (66.66%) remained between 15 and 30 db.: that is to say, 103 cases (85.83%), in this group, reached social level.

Av. Generalísimo, 427.

## REFERENCES

1. García-Ibañez, L.: Cirugía funcional de las otorreas por la vía del conducto. Med. españ. 23:91-98 (Feb.) 1950.

2. García-Ibañez, L.: Microcirugía funcional en las otorreas, Proceedings of the Fifth International Congress of Oto-Rhino-Laryngology, June, 1953, Med españ. 29:477-481 (June) 1953.

3. García-Ibañez, L.: Micro-chirurgie fonctionnelle des otorrhées: Étude audiométrique comparative des diverses méthodes, Congress of the International Society of Audiology, Paris, January, 1955, Rev. laryng. 76:800-807 (Nov.-Dec.) 1955.

4. Garcia-Ibañez, L.: Valoracion funcional de la columelizacion del oido medio, Sociedad española de otorrinolaring, Oct., 1955.

5. García-Ibañez, L.: Nuevas orientaciones en la cirugía funcional de las otorreas, An. soc. otorinolaring. andaluz. pp. 413-420, June, 1951.

6. García-Ibañez, L.: Microcirgía funcional en las otorreas, Acta oto-rino-laring. ibero-am., No. 6, 1952.

7. Iturriagagoitia, J. R.: Recuperación quirúrgica de las sorderas de oido medio no otoesclerosas, Med. clín., Barcelona 12:342-346 (May) 1949.

8. Garcia-Ibañez, L.: Tratamiento quirúrgico de la sordera, II Jornadas médicas Aragonesas, Zaragoza, May, 1953.

9. Wullstein, H.: Prognose und Resultat der Tympanoplastik, Acta oto-laryng. 45:440-454 (Sept.-Oct.) 1955.

10. Antoli-Candela, F.: Vaciamiento radical y fenestración en las hipoacusias por otorrea, Acta otorrinolaring. españ., Jan.-March, 1953.

11. Antoli-Candela, F.: Necesidad de una revisión en la cirugía radical del oido, Acta otorrinolaring. españ., Vol. 4, 1952.

12. Antoli-Candela, F.: Técnicas quirúrgicas para el tratamiento de las sorderas por otorrea y otoesclerosas, read before the Fifth International Congress of Oto-Rhino-Laryngology, Amsterdam, June, 1953.

13. Antoli-Candela, F.: Técnicas de audiocirugía, read before the International Congress of Audiology, 1953.

14. García-Ibañez, L., and Antoli-Candela, F.: Cirugía funcional de las otorreas, Ponencia oficial, Sociedad española de otorrinolaring., June, 1956.

15. Zöllner, F.: Hörverbessernde Eingriffe an Schalleitungsapparat, read before the Fifth International Congress of Oto-Rhino-Laryngology, Amsterdam, June, 1953.

16. Wullstein, H.: Die Tympanoplastik als gehörverbessernde Operation bei Otitis media chronica und ihre Resultate, read before the Fifth International Congress of Oto-Rhino-Laryngology, Amsterdam, June, 1953.

17. Pietrantoni, L.; Bocca, E., and Agazzi, C.: Premiers résultats de la tympanoplastie dans les expériences de la clinique oto-rhino-laryngologique de l'Université de Milan, Rev. Laryng. 76:10-23 (Jan.-Feb.) 1955.

18. Bocci, and Carnevale-Ricci.: La Chirurgia Funcionale Dell 'Orechio Medio, report presented at the Congress of the Italian Society of Otorhinolaryngology, Naples, 1955.

19. Abstracts of the Sixth International Congress of Otolaryngology, Washington, D. C., May, 1957.

20. García-Ibañez, L.: Microcirugía funcional de las otorreas: Indicaciones y comentarios, read before the joint meeting of the Otorhinolaryngological Societies of Bordeaux and Barcelona, March, 1956.

21. García-Ibañez, L.: Cabezal funcional para la moderna cirugía, otológica Rev. españ. oto-neuro-oft. 15:291-293 (May-June) 1956.

22. García-Ibañez, L.: Un perfeccionamiento de la radical de oido: El cierre osteogenético de la trompa, An. otorinolaring. andaluz., 1951.

23. Hughson, W.: A Summary of Round Window Graft Operations Performed for Deafness, Ann. Otol. Rhin. & Laryng. 49:384-393 (June) 1940.

24. Tato, J. M., and de Sebastian, G.: Técnica quirúrgica reparadora del oido medio, Acta oto-rino-laring. ibero-am. 8:65-92, 1957.

# Primary Hemangioma of the Nasal Bones

*Report of a Case*

FRED W. BECK, M.D.; C. W. BUNNELL, M.D., and R. E. SWENSON, M.D., Oakland, Calif.

This is the fourth case of hemangioma of the nasal bones to be reported in the literature. The three previous cases were reported by Neivert and Bilchick [1] in 1936, Bloom [2] in 1954, and by Moore and Pearce [3] in 1956.

The first three cases were all in white females. This fourth one to be reported was in a white man. This probably has no real significance.

We used a comparatively new type of material for filling in the defect. This was despeciated mandibular bone from a calf fetus as prepared and furnished by Tucker.[4]

Submitted for publication Nov. 6, 1958.

Fig. 1.—Frontal x-ray of nasal bones shows peculiar bulging of the bones.

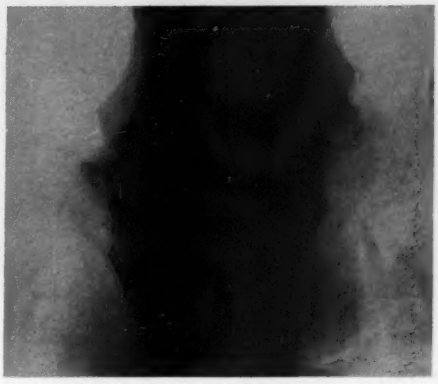


Fig. 2.—Lateral x-ray of nasal bones shows characteristic sunburst striated markings.

To date there has been no indication of absorption of this material, and the cosmetic appearance is very good.

Fig. 3.—Photograph of tumor exposed, in situ.

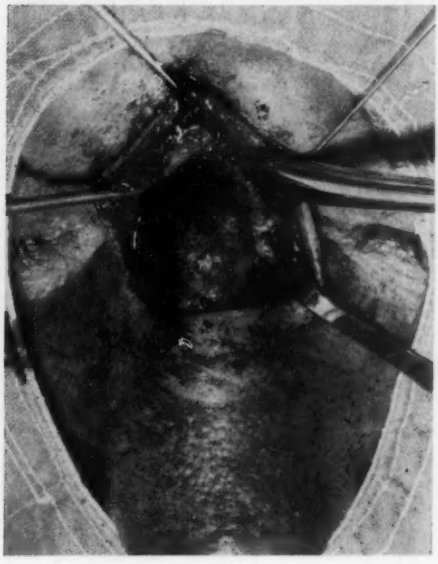


Fig. 4.—Photograph of bed after removal of tumor, showing intact nasal mucosa, septum, and remaining portion of frontal processes of maxillary bones.

In our case we were able to preserve completely intact the nasal mucosa, although it was quite widely exposed by removal of the tumor mass, portions of both nasal bones, and a part of the frontal processes of the maxillary bones.

Fig. 5.—Photograph of tumor after removal. Upper surface.

Moore and Pearce,[3] and Holmes, Sweet, and Keleman[5] have reviewed the literature very thoroughly regarding hemangiomas of the nasal bones, the nose, and the frontal and parietal bones.

## Report of Case

The patient reported pain at the base of the nose at times and a swelling which he had noted for the past six years. This had gradually increased in size and was sensitive to touch.

The past history was essentially negative. The general physical condition was quite normal except for the nasal findings. The patient was a well-developed, well-nourished, white, 55-year-old man. The nasal examination showed a rather firm, smooth mass over the bony vault area, apparently bulging between and separating the nasal bones. The skin of the nose was coarse. Intranasally, the septum was quite straight, the turbinates quite normal, and there was no evidence of any tumor mass or other pathology. His height was 69 in.; weight, 154 lb.; blood pressure, 166/90. The lungs were clear. There was no cardiac enlargement. The EKG was normal.

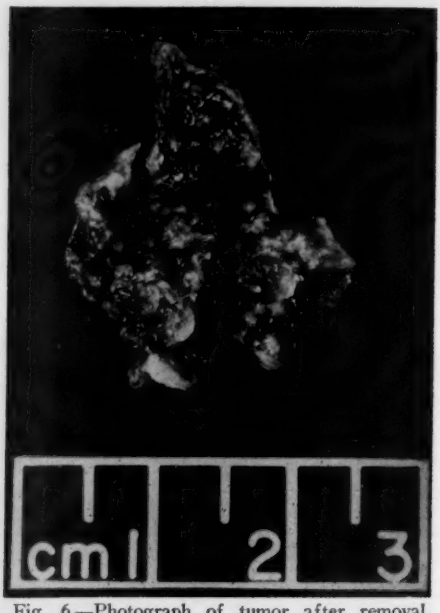



Fig. 6.—Photograph of tumor after removal. Deep surface.

X-rays: Chest (Jan. 8, 1958): The heart and lungs were within normal limits.

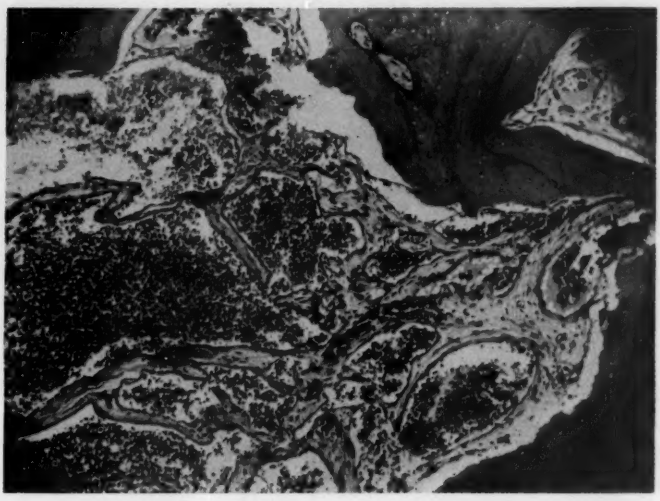


Fig. 7. — Photomicrograph of section stained with hematoxylin and eosin shows tortuous interlacing blood vessels separated by collagenous connective tissue. The lumina show flattened endothelial cells and contain masses of erythrocytes. Hemosiderin pigment is noted in the interstitium. Reduced about 12% from mag. × 100.

Nasal Bones (Jan. 8, 1958): The nasal bones showed a peculiar bulging of the bones with irregular striated markings characteristic of hemangioma of the bones. This bulging occupied approximately two-thirds of the bones, near the middle. The cortices were somewhat bulged, and the tumor mass in toto was approximately 1.5 cm. in diameter. In addition, there was a chip fracture of the tip of the nasal bones apparently ununited to the main bones. Since this was a somewhat unusual type of lesion, the employment of magnification study was suggested for further evaluation.

Sinuses (Jan. 15, 1958): The frontal sinuses were poorly developed, consisting of supraorbital buds. They seemed clear otherwise. The ethmoid cells showed some clouding and septum demineralization bilaterally. The antra and sphenoids were clear.

Laboratory Tests: Negative.

Surgery: Surgical removal of the tumor mass was accomplished under local anesthesia of 1% lidocaine (Xylocaine) with epinephrine, 1:30,000, on Jan. 31, 1958, at the Veterans Administration Hospital in Oakland, Calif.

Fig. 8.—Preoperative photograph showing swelling over nasal bones. Oblique view.

Fig. 9.—Preoperative photograph showing swelling over nasal bones. Frontal view.

Fig. 10.—Preoperative photograph showing swelling over nasal bones. Right lateral view.

Fig. 11.—Preoperative photograph showing swelling over nasal bones. Left lateral view.

The patient was prepared and draped. An L-shaped incision was made through the skin over the left nasal bone, beginning at about the level of the inner canthus and extending downward to near the caudal border of the left nasal bone, then extending to just beyond the midline on the right. The soft tissue flap was elevated by blunt dissection with scissors. Considerable subcutaneous tissue was preserved with the reflected skin. The tumor mass was rather soft, rounded, and of a reddish hue. This was carefully delineated by scissors and MacKenty elevator. A piece was taken from the superior surface for frozen section. About ⅛ in. of normal bone beyond the tumor mass was separated with chisel and hammer. This included nasal bones and frontal processes of the maxillary bones bilaterally.

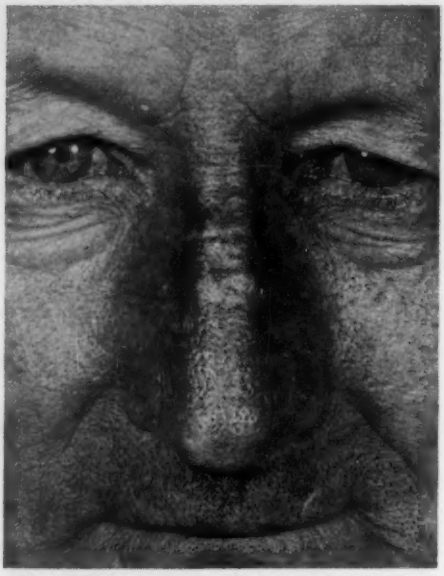


Fig. 12.—Photograph, five months postoperatively, showing restitution of nasal dorsum. Frontal view.

The tumor was most firmly attached on its deep surface. It was removed intact together with the surrounding bone. This exposed the roof portion of the nasal mucosa between the septum and the lateral walls; it was preserved intact.

The defect was large. Implants of approximately 1 cc. of crushed isogenous septal cartilage and 7 cc. of crushed despeciated calf mandibular bone were used to fill the defect.

The skin flap was closed with multiple 5-0 Dermalon sutures. A tape splint and dental stent mold were applied.

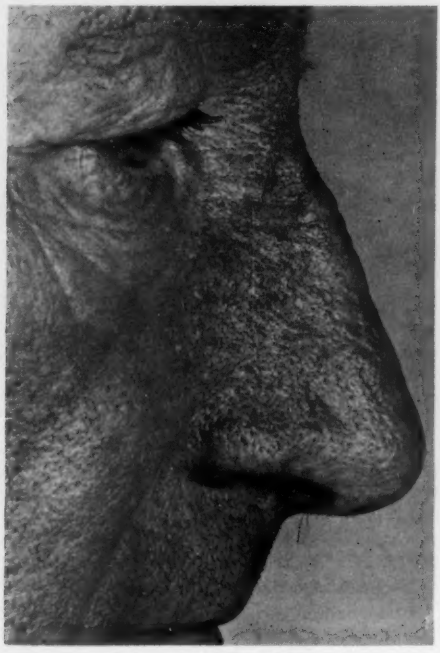


Fig. 13.—Photograph, five months postoperatively, showing restitution of nasal dorsum. Right lateral view.

Fig. 14.—Photograph, five months postoperatively, showing restitution of nasal dorsum. Left lateral view.

The postoperative course was uneventful. The Dermalon sutures were removed on the fifth day postoperatively.

Nine months later there has been no indication of infection, recurrence of tumor, or of absorption of the implant material. In fact, we put in a slight excess of material with the expectation of some absorption, but such has not occurred.

Pathologic Report, given by Dr. Livia Ross on Feb. 6, 1958:

Macroscopic Examination: The gross main specimen measured 1.8 cm. in greatest diameter. One surface showed a slightly convex appearance covered by a thin, moderately glistening membrane, beneath which some dilated, distended blood vessels were seen. At one corner there was a slightly protruding extension of it which appeared osseous in nature. On palpation, the whole specimen had an osseous feel to it. On the cut surface, beneath a very thin layer, a bony structure was seen which was intensely congested, and had a purple color.

Microscopic Examination: Soft tissue fragments used for frozen section showed a cavernous hemangioma represented by tortuous interlacing and intercommunicating blood vessels which were separated from each other by a thicker to thinner layer of collagenous, connective tissue. The lumina showed flattened endothelial cells.

Masses of erythrocytes were found in some of the gaping lumina. Other areas showed smaller, less intercommunicating blood channels, also with flattened endothelium, and some increased amount of connective tissue condensated in between. These represented areas of more capillary type of hemangioma. Some hemosiderin pigment was also noted in the interstitium. The fragments which were decalcified showed bony lamellae which showed normal histology. They were spread apart by the same type of mostly cavernous hemangiomatous type of growth showing the same type of blood channels with thin to thicker walls lined with endothelium. Large lumina with erythrocytes were seen in between the bony lamellae. Occasionally some new osteoid formation was seen with early deposits of calcium, suggesting early lamella formation. The periosteal tissue also showed a tortuous, cavernous, and capillary type of hemangioma.

Diagnosis: Cavernous and capillary hemangioma, infiltrating nasal bones. Note: This lesion is benign.

## Comment

As Neivert and Bilchick[1] have stated, the cause of hemangioma of the bone is unknown. The growth begins in the vascular

spaces of the bone; the blood channels increase in size and number until the cortex is penetrated, but the periosteum remains intact though stretched over the growing mass. The sunburst appearance seen by roentgen ray is characteristic and pathognomonic of this benign tumor. This is due to the spicules of bone radiating from a common center and extending perpendicular to the plane of the bone.

By way of differentiation, a sarcoma usually breaks through the periosteum and invades adjacent structures.

## Summary

A case of hemangioma of the nasal bones is reported. It is the fourth report to appear in the literature.

A tentative diagnosis was made preoperatively because of x-ray findings and was confirmed by the postoperative microscopic examination.

The lesion was removed surgically, and normal bone about the lesion was included in the excision.

The operative defect was corrected by the use of crushed despeciated calf fetus mandibular bone and crushed isogenous septal cartilage.

At the end of nine months there is no evidence of recurrence of the tumor or of absorption of the implant.

411 30th St. (9).

## REFERENCES

1. Neivert, H., and Bilchick, E. B.: Primary Hemangioma of the Nasal Bone, Arch. Otolaryng. 24:495-501 (Oct.) 1936.

2. Bloom, S. M.: Hemangioma of Nasal Bone: Excision and Repair by Bone Graft, Eye, Ear, Nose & Throat Month. 33:596-598 (Oct.) 1954.

3. Moore, J. A., and Pearce, J. M.: Hemangioma of the Nasal Bone: Report of a Case, Ann. Otol. Rhin. & Laryng. 65:1012-1019 (Dec.) 1956.

4. Tucker, E. J.: Studies on Calf Bone Preserved in Plasma for Human Implantation, presented at Annual Meeting, American Rhinologic Society, Chicago, Oct. 19, 1957.

5. Holmes, E. M.; Sweet, W. H., and Keleman, G.: Hemangiomas of the Frontal Bone: Report of 3 Cases; Ann. Otol. Rhin. & Laryng. 61:1:45-61 (March) 1952.

# Ciliary Beat Rates in Sinus and Bronchial Mucosa from Bronchiectatic Persons

TORE DALHAMN, M.D.; GÖSTA EVERT, and TORBJÖRN FAHLÉN, Stockholm, Sweden

Interest in the problem of bronchiectasis has been particularly enhanced by the recent advances in thoracic surgery. The abundant literature comprises extensive clinical reviews [1-3] as well as experimental investigations.[4-7]

The cause of bronchiectasis and the relationship of this condition to chronic sinusitis have been intensively discussed. For present purposes, however, detailed penetration of these questions is superfluous. We would only point out that changes in the ciliary activity and in the mucus secreted in the respiratory tract have been suggested as possible factors in the development of bronchiectasis and atelectasis.[6,7]

Our investigations were intended to provide an orientating conception as regards ciliary activity in bronchiectasis and chronic sinusitis. We therefore measured the rate of ciliary beat on sinus mucosa and bronchial mucosa excised from persons with chronic sinusitis and/or bronchiectasis. For comparison, we also measured ciliary beating on specimens of mucosa from the same sites in persons without such affections.

Ten persons were studied. Four of them provided the control specimens, (one of sinus mucosa and three of bronchial mucosa taken from healthy regions of lungs extirpated for tumor). Of the six patients who provided the pathologic specimens, two had only chronic sinusitis, two had only bronchiectasis, and two had both conditions simultaneously. Three of the six patients were children from 5 to 16 years old, all of them bronchiectatic.

Immediately after excision the specimens of mucosa were placed in a moist container at a temperature of 37 C. This container consisted of a wide-mouthed Thermos flask filled with water which had been heated to 37 C. In the upper portion of the flask, without contact with the water, was placed a plastic bag with a perforated bottom and this held the specimens during transportation.

So that the readings in the tests could be regarded as representative, it was essential that the mucosa should not have been exposed to any form of local anesthesia. The sinus specimens were therefore taken at operations performed under intratracheal anaesthesia when the nasal mucosa was not locally anesthetized, as intubation was performed through the mouth. To ascertain that the specimens obtained were those desired, for instance from the bronchiectatic lung, the tissue was first examined macroscopically and later, after registration of ciliary beating, histologically. The ciliary activity was determined by the method devised and described by Dalhamn.[8]

The results of the investigations are summarized in Tables 1 and 2.

TABLE 1.—*Rate of Ciliary Beat (Beats/Min.) in Sinus Mucosa*

| Normal Specimen | Chamber Temperature, C | Pathologic Specimens | Chamber Temperature, C |
|---|---|---|---|
| 770 | 37.0 | 753 | 37.2 |
| | | 969 | 37.2 |
| | | 624 | 37.0 |
| | | 953 | 37.4 |

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From the Institute of Hygiene, Karolinska Institute, and the Otologic Clinic, Sabbatsberg Hospital.

TABLE 2.—*Rate of Ciliary Beat (Beats/Min.) in Bronchial Mucosa*

| Normal Specimens | Chamber Temperature, C | Pathologic Specimens | Chamber Temperature, C |
|---|---|---|---|
| 1,033 | 36.9 | 978 | 37.4 |
| 1,042 | 37.7 | 1,404 | 37.3 |
| 975 | 37.0 | 1,308 | 37.3 |
| | | 980 | 36.8 |
| | | 1,050 | 37.2 |
| | | 1,174 | 37.0 |

Histologic analysis of the specimens confirmed that all the controls were of normal mucosa. As regards the pathologic specimens, one from a patient with sinusitis displayed only moderate round-cell infiltration. The other sinus specimens consisted of swollen, hyperemic mucosa, sometimes with abundant eosinophilic leukocytes. The bronchial mucosa was severely altered.

## Comment and Summary

The causal mechanism of chronic sinusitis and of bronchiectasis is widely discussed, and many factors have been suggested. A possible contributory cause is alteration in some way of the ciliary activity, since the secretory stagnation which presumably would be the primary result might provide conditions for bronchiectatic changes. In six cases of chronic sinusitis and/or bronchiectasis the rate of ciliary beat was measured in specimens from the diseased areas. The frequencies found did not differ notably from results of measurements on normal mucosa.* Although there is no direct reason to assume alteration (towards equalization) of the phases of the single ciliary beat, this question should be investigated before the possible contribution of the cilia to the development of bronchiectasis can finally be decided.

Statens Institut jör Folkhälsan, Tomteboda, Sweden.

* For obvious reasons only a single specimen of healthy sinus mucosa could be obtained. The rate of ciliary beat registered from it, however, was comparable in order of magnitude with the frequencies found in the pathologic specimens.

## REFERENCES

1. Ogilvie, A. G.: Arch. Int. Med. 68:395, 1941.
2. Clagett, O. T.: Proc. Interst. Postgrad. M. A. North America, p. 270, 1945.
3. Davidson, F. W.: Ann. Otol. Rhin. & Laryng. 53:849, 1944.
4. Hilding, A. C.: Ann. Otol. Rhin. & Laryng. 52:5, 1943.
5. Hilding, A. C.: Ann. Otol. Rhin. & Laryng. 52:816, 1943.
6. Harford, C. G., and Hemling, A.: J. Exper. Med. 95:173, 1952.
7. Baker, J. M.; Roettig, L. C., and Curtis, G. M.: Ann. Surg. 134:641, 1951.
8. Dalhamn, T.: Acta physiol. scandinav. 36; Supp. 123, 1956.

# Primary Diphtheritic Otitis Media

*Review of the Literature and Report of a Case*

**JOHN J. DOWNES, M.D., Tacoma, Wash.**

The purpose of this paper is to review the literature on primary diphtheritic otitis media since 1925, when the last comprehensive study was published,[1] to report in detail a case recently encountered, and to discuss various facts pertinent to this infection.

Since 1925, 22 cases have been reported in American and English literature; 17 of these were described in detail. The cases have been summarized in table form.

For the purposes of this review, the criteria by which a case of otitis media is classified as primary diphtheritic are as follows:

1. The middle ear was the site of the major pathology.
2. A positive culture for Corynebacterium diphtheriae was obtained from the aural discharge.
3. Nasopharyngeal cultures, when obtained, were negative at the time of the first positive ear culture. In some instances nasopharyngeal cultures later were positive.

In a recent study[2] of 1,433 cases of bacteriologically proved diphtheria, primary diphtheritic otitis media was diagnosed in only 5 patients. This number accounts for 0.3% of all types of diphtheria. Diphtheritic otitis media is more frequent as a complication of preexisting nasopharyngeal diphtheria.[3-5] In large case studies this secondary form occurred in 2% of all forms of diphtheria.[2,6] C. diphtheriae or diphtheroids also may be superimposed upon an existing otitis media caused by another organism (e. g., Streptococcus or Pneumococcus).[4,7]

The age range of patients whose case reports have been studied here varied from 9 months to 38 years, but 75% were under 6 years.

In 1920, Lambert first described a triad of symptoms for this infection. These symptoms were (1) persistent pain in the ear, often severe; (2) bulging with eventual rupture of the tympanum, and (3) discharge of serosanginuous or purulent exudate, sometimes containing necrotic gray-white portions of membrane.[8] This triad still appears in textbooks [4,5] and is generally applicable, although cases have been reported which present quite variable pictures.[8-10] From a clinical standpoint, it is evident that diphtheritic otitis often cannot be readily differentiated from purulent otitis caused by other organisms. The only clinical evidence which may suggest aural diphtheria is the membrane formation on the tympanum or in the external canal. However, this membrane was found in only 23% of the cases described. In all instances the final diagnosis had to be made by culture of the exudate on Loeffler's or other special media.

Every case report described an aural discharge which gave a positive culture for C. diphtheriae. Differentiation from diphtheroids was made on the basis of staining and morphological characteristics and in some cases by guinea pig virulence tests. Pure cultures were obtained in all but two cases [12,13]; the response to antitoxin in both of these instances proved C. diphtheriae to be the primary etiologic organism.

Although avirulent stains may produce clinical infection,[8,12] the guinea pig virulence test is thought by some investigators to be essential to the diagnosis of diphtheritic infection.[13,14] However, Geiger and Marshall [15] point out that virulence tests may be

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U. S. Public Health Service, Indian Hospital.
Former Address: Indian Health Center, Chamberlain, S. D.

*Cases of Primary Diphtheritic Otitis Media Reported in the Literature, 1925-1957*

| Author and Reference | Year | Age | Ear Culture and Virulence (Guinea Pig) | Nose-Throat Culture for C. Diphtheriae | Type of Exudate | Membrane in Ear | Complications | Treatment (Total Antitoxin & Surgery) | Sequelae | Recovery, Time |
|---|---|---|---|---|---|---|---|---|---|---|
| Drury[1] | 1925 | 18 mo. | C. diphtheriae vir. (+) | Negative | Purulent | Present | Probable mastoiditis, bilateral involvement | Antitoxin — 6,000 u.; myringotomy | None | 8 wk. |
| | | 9 mo. | C. diphtheriae vir. (+) | Negative | Purulent | Absent | Probable mastoiditis, bilateral involvement | Antitoxin — 10,000 u.; myringotomy | None | 4 wk. |
| Friesen[3] | 1925 | 34 yr. | C. diphtheriae vir. (?) | Negative | Serosanguinous | Absent | Marked toxicity with shock | Antitoxin — 80,000 u.; myringotomy | None | 3 wk. |
| | | 23 yr. | C. diphtheriae vir. (?) | (?) | Serous | Absent | None | Antitoxin — 60,000 u. | Total loss of tympanum | Rapidly |
| Costen[4] | 1927 | 3 yr. | C. diphtheriae vir. (+) | (?) | Serosanguinous | Absent | Chronic mastoiditis; marked weight loss for one year | Antitoxin — 10,000 u.; mastoidectomy | None | Rapidly |
| | | 1 yr. | C. diphtheriae vir. (—) | (?) | Purulent | Absent | Mastoiditis, bilateral involvement | Antitoxin — 5,000 u.; mastoidectomy | None | 4 wk. |
| Nussbaum[10] | 1929 | 2 yr. | C. diphtheriae vir. (?) | Positive | Purulent | Present | Marked toxicity; probable mastoiditis | Antitoxin — 10,000 u.; myringotomy | None | 4 wk. |
| | | 38 yr. | C. diphtheriae vir. (?) | Positive | Serosanguinous | Present | Probable mastoiditis | Antitoxin — 20,000 u.; myringotomy | None | 1 wk. |
| | | 6 yr. | vir. (?) | Positive | Purulent | Absent | Mastoiditis, bilateral involvement | Antitoxin — 20,000 u. | None | 1 wk. |
| Stroud[11] | 1931 | 32 yr. | C. diphtheriae vir. (?) | Positive | Purulent | Present | None | Antitoxin — 40,000 u. | None | 1 wk. |
| | | 4 yr. | C. diphtheriae vir. (?) | Positive | Purulent | Absent | None | Antitoxin — 10,000 u. | None | 1 wk. |
| | | (?) | C. diphtheriae vir. (?) | (?) | Purulent | Absent | Chronic aural discharge — 14 mo. | Antitoxin — 20,000 u. | None | 3 wk. |
| | | 4 yr. | C. diphtheriae vir. (—) | Negative | Purulent | Absent | None | Antitoxin — 10,000 u. | None | Promptly |
| | | 11 yr. | C. diphtheriae vir. (?) | Positive | Purulent | Absent | None | Antitoxin — 10,000 u. | None | 1 wk. |
| Keller[12] | 1941 | 4 yr. | C. diphtheriae vir. (?) | Negative | Purulent | Absent | Bilateral involvement | Antitoxin — 20,000 u.; myringotomy | None | Rapidly |
| | | 4 yr. | C. diphtheriae vir. (—) | Negative | Serosanguinous | Absent | None | Antitoxin — 20,000 u.; myringotomy | None | 1 wk. |
| | | 11 yr. | C. diphtheriae vir. (—) | Negative | Purulent | Absent | Bilateral involvement | Antitoxin — 10,000 u. | None | Promptly |
| Naiditch[8] | 1954 | | Five primary cases with positive cultures reported, but not described | | | | | | | |

misleading. This view is supported by three cases of primary diphtheritic otitis media reported by Keller [12] in which guinea pig inoculation was negative.

Complications of primary diphtheritic otitis media were quite frequent. Acute mastoiditis was diagnosed in 35% of the cases; one case of chronic mastoiditis was described. Three cases, none of which had nasopharyngeal involvement, exhibited profound toxicity. Although none of the cases described became carriers, the middle ear can harbor C. diphtheriae in a carrier state.[14,16,17] It is thus obvious why aural diphtheria is regarded as a potentially dangerous infection.[18]

The most important factor in the management of all cases was the use of diphtheria antitoxin. The dosage was varied according to age, toxicity, and duration of symptoms. In adults the average was 20,000 units, in children 10,000 units. Myringotomy was performed in eight, and mastoidectomy in two of the cases described. Signs and symptoms usually subsided within three weeks, and all of the documented cases recovered without major sequelae.

When the aural carrier state develops, its eradication is most readily accomplished (as with other carrier forms) by appropriate antibiotic therapy. Antitoxin has little effect.[19] Penicillin is the antibiotic of choice in 75% of the cases.[17,20,21] Where the organism is penicillin-resistant, chlortetracycline,[18] oxytetracycline,[21] and erythromycin [22] are usually effective. One case reported in 1951 by Karelitz [17] reverted to a negative ear culture only after large doses of intramuscular dihydrostreptomycin.

## Report of Case

On Sept. 30, 1957, a 21-year-old American Indian woman, 34 weeks pregnant, reported to the clinic complaining of a painless discharge from the left ear for one week. She denied previous ear infections, and past history was noncontributory.

Examination of the left ear revealed copious gray-white purulent exudate in the external canal. The drum was bulging and inflamed. The opposite ear, nose, and throat were normal. The patient was afebrile, and the remainder of a routine prenatal check was negative.

With the use of a flame-sterilized wire, a sample of exudate was obtained from close to the tympanum and streaked on Loeffler's media for routine culture and sensitivities at the State Health Laboratories.

After the external canal was cleansed with dry cotton wipes, the patient was given benzathine penicillin G, 1,200,000 units intramuscularly. Oral trisulfapyrimidines (triple sulfonamides) and an otic solution of sulfanilamide with urea and chlorobutanol were prescribed.

The laboratory later reported that the culture had yielded a pure growth of C. diphtheriae with typical morphology and positive virulence proved by guinea pig inoculation. Sensitivity to penicillin was not determined, but the organism did exhibit sensitivity to chloramphenicol.

The patient could not be contacted until six days after the initial visit. At this time she stated the external discharge had ceased two days previously. She denied recent sore throats, skin lesions, or wounds. There was no past history of diphtheria or contact with known diphtheria at any time. She had never been immunized against diphtheria.

Examination of the involved ear revealed a markedly inflamed tympanum with a small, dry posterior perforation without evidence of membrane formation. Again, examination of the opposite ear, nose, and throat was negative. Repeat cultures of the involved ear and nasopharynx were reported to show no growth of C. diphtheriae. White blood count and urinalysis were normal.

Diphtheria antitoxin (20,000 units) and diphtheria-tetanus toxoid (0.5 cc.) were given intramuscularly in separate sites. Antibiotic therapy was changed to chloramphenicol orally and chloramphenicol 0.5% otic solution.

Because the patient was not toxic and isolation facilities at the local hospital were limited, it was decided to isolate the patient and her family at home. Nasopharyngeal cultures from members of the family and other contacts were all negative.

After one week of chloramphenicol therapy the involved ear as well as the rest of the upper respiratory tract appeared normal. Negative cultures were obtained at this time and two weeks after discontinuing therapy. Follow-up included cultures at two-month intervals for eight months. There has been no evidence to suggest a carrier state.

## Comments

From the review of the literature it is apparent that primary diphtheritic otitis media is a very rare but potentially dangerous infection. Marked toxicity can be pro-

duced without nasopharyngeal involvement, and complications such as mastoiditis are frequent in untreated cases. Naiditch and Bower[2] in their excellent paper on diphtheria offer two important comments which apply here:

1. Atypical forms of diphtheria are usually not diagnosed early, yet with little or no premonitory systemic reaction can lead to major complications (neuritis, myocarditis, pneumonitis).

2. The incidence of complications is directly related to the length of the interval from the onset of infection to administration of antitoxin. Thus, early definitive diagnosis of atypical diphtheria is imperative.

The diagnosis of this infection depends primarily on examination of smear and culture of the aural discharge. The correct diagnosis can be delayed by the use of media unsuitable for isolation of C. diphtheriae.[9] Loeffler's media, is very stable and relatively inexpensive.[23] It also facilitates the early diagnosis of unsuspected diphtheria. Therefore, the use of Loeffler's media in addition to agar media for routine ear, nose, and throat culture is recommended.

When considering a diagnosis of primary aural diphtheria, it should be recalled that although a positive guinea pig virulence test lends support, a negative test does not exclude C. diphtheriae as the primary etiologic organism.

The use of antibiotics in conjunction with antitoxin is recommended to hasten eradication of diphtheria bacilli from the focus of infection and to prevent development of a carrier state. Penicillin is effective in most cases.[17,20] However, it must be emphasized that antibiotics have no antitoxic properties and thus are not a substitute for antitoxin.[2,14,18,24,25] Cure of the established carrier state is effected in most instances by appropriate antibiotic therapy.

In the case reported here, it is interesting to note that the otorrhea subsided and culture became negative after a single large dose of benzathine penicillin and sulfonamide therapy for one week, although marked inflammation of the tympanum persisted. The question arises as to whether this patient would have had an uneventful recovery without antitoxin. A preponderance of evidence in the literature indicates that complete recovery without antitoxin would have been very unlikely.

## Summary

The literature since 1925 pertaining to primary diphtheritic otitis media has been reviewed and discussed. An analysis of the 22 cases which have been reported and salient points in regard to the incidence, diagnosis, complications, and treatment of this entity are presented.

A recent case which I encountered is described in detail.

The hazards of atypical forms of diphtheria, advantages of the routine use of Loeffler's media, the significance of virulence tests, and the role of antibiotics in the therapy of diphtheria and carrier states are discussed.

Several conclusions are reached concerning the diagnosis and therapy of this rare, potentially hazardous infection.

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U. S. Public Health Service, Indian Hospital.

## Addendum

Since the original writing of this paper, three additional cases of suppurative otitis media in infants yielding a pure culture of virulent C. diphtheriae have been diagnosed and successfully treated.

## REFERENCES

1. Drury, D. W.: Diphtheria of the Ear, Arch. Otolaryng. 1:221-230, 1925.

2. Naiditch, M. J., and Bower, A. G.: Diphtheria, Am. J. Med. 17:229-245, 1954, pp. 229, 236.

3. Boies, L. R.: Fundamentals of Otolaryngology, Ed. 2, Philadelphia, W. B. Saunders Company, 1954, pp. 82 and 349.

4. Cooke, J. V., in Cyclopedia of Medicine, Surgery, and Specialties, Philadelphia, F. A. Davis Company, 1957, Vol. 4, p. 669.

5. Rolleston, J. D., and Ronaldson, G. W.: Acute Infectious Diseases, Ed. 3, St. Louis, The C. V. Mosby Company, 1940, pp. 20, 39.

6. Togaski, Y.; Rosove, L.; Bower, A. G., and Hamilton, P. M.: Treatment, Complications and

Deaths in 753 Cases of Clinical Diphtheria, Am. J. M. Sc. 204:218-227, 1942.

7. Parsons, L., and Barling, S., editors: Diseases of Infancy and Childhood, Ed. 2, London, Oxford University Press, 1954, Vol. 2, pp. 1848, 1865.

8. Friesen, J. F.: Primary Diphtheritic Otitis Media, Laryngoscope 35:545-547, 1925.

9. Costen, J. B.: Diphtheritic Infection of the Middle Ear and Mastoid, Arch. Otolaryng. 5:119-121, 1927.

10. Nussbaum, D.: Diphtheria of the Ear, Arch. Otolaryng. 10:296-298, 1929.

11. Stroud, E. F.: Diphtheritic Otitis Media and Mastoiditis with a Report of Cases, Texas J. Med. 26:662-665, 1931.

12. Keller, W. F.: Diphtheria of the Middle Ear, J. Oklahoma M. A. 34:519, 1941.

13. Fowler, E. P., Jr.: Bacteriology of Acute Otitis Media, Canad. M. A. J. 44:372-380, 1941, pp. 375, 376.

14. Harries, E. H. R.: The Problem of the Diphtheria Carrier, Practitioner 159:446-451, 1947, pp. 447, 450.

15. Geiger, J. C., and Marshall, M. S.: Diphtheria Revised, Arch. Pediat. 67:495-502, 1950, pp. 500, 502.

16. Shen, J. T. Y.: Penicillin Treatment of Diphtheria Carriers, Pediatrics, 4:188-195, 1949, pp. 188, 194.

17. Karelitz, S.; King, H., and Rubinstein, I. S.: Aureomycin Treatment of Diphtheria and Diphtheria Carriers, J. Pediat. 39:544-548, 1951, pp. 547, 548.

18. Ballenger, H. C., and Ballenger, J. J.: Diseases of the Nose, Throat and Ear, Ed. 10, Philadelphia, Lea & Febiger, 1957, p. 657.

19. Medwick, J. X., and Hallberg, O. E.: Treatment of Chronic Nasal Diphtheria Carriers: Report of a Case, Ann. Otol. Rhin. & Laryng. 57: 134-142, 1948.

20. Karelitz, S., and Spinelli, V. A.: Penicillin Treatment of Diphtheria Carriers, Pediatrics 3: 639-644, 1949, p. 644.

21. Lall, S., and Karelitz, S.: Treatment of Diphtheria and Diphtheria Carriers with Terramycin, J. Pediat. 43:35-37, 1953, p. 37.

22. Beach, M. W.; Gamble, W. B., Jr.; Zemp, C. H., Jr., and Jenkins, M. Q.: Erythromycin in Treatment of Diphtheria and Diphtheria Carrier States, Pediatrics 16:335-343, 1955, p. 343.

23. Diamond, B. E., Director, South Dakota State Health Laboratories: Personal communication to the author, 1958.

24. Crawford, J.: Penicillin in Treatment of Diphtheria and Diphtheria Carrier State, New England J. Med. 239:220, 1948.

25. Jackson, G. G.; Chang, S. M.; Place, E. H., and Finland, M.: Sensitivity of Diphtheria Bacilli and Related Organisms to 9 Antibiotics, J. Pediat. 37:718-726, 1950.

# The Otolaryngologist and the Symptom of Hyper-Rhinolalia

ESTI D. FREUD, Ph.D., New York

In his private as well as in his clinical practice the otolaryngologist will with relative frequency have to decide what kind of therapy to prescribe as remedy for a disorder which in layman's language is called "a nasal twang." This term, far from being exact, usually indicates that a patient's voice is affected by some sort of nasal distortion unpleasant to the perceiving ear.[1]

In such cases the ear, nose, and throat specialist will state that his patient is afflicted by rhinolalia, and it will be his diagnostic task to determine whether the rhinolalia is of the hyper-, hypo-, or mixed type.*

For a phonetically untrained ear it may not always be very easy to make the correct distinction among the three types of rhinolalia, and, since therapy is completely different for each one of them, we advise the use of a simple tool, whose application will ascertain a foolproof diagnosis. At each end of a rubber tube, taken from an ordinary stethoscope, a glass olive is inserted; one of these olives is put into the patient's naris, the other into the examiner's own ear. The patient is told to say four or five times consecutively, "ee-oo, ee-oo, ee-oo." Whenever the examiner detects an unpleasant noise in his listening ear, the unequivocal diagnosis is "hyper-rhinolalia."

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From Speech Clinic, of the Ear, Nose, and Throat Department, of the Harlem Eye and Ear Hospital.

* During the early 30's E. Froeschels introduced the terms hyper-rhinolalia, hyporhinolalia, and mixed rhinolalia, replacing the former terminology of rhinolalia aperta and rhinolalia clausa, the new terms being more in accordance with the pathologic processes involved.

The next test—executed by means of the same instrument—consists of letting the patient "hum." While the patient says a prolonged, "m-m-m-m-m-m-m," with the glass olive inserted in his nostril, the examiner continues to listen as just described. If no sound or only a weak sound is perceived by the examiner as coming through the rubber tube the diagnosis is "hyporhinolalia." In those cases the patient's speech sounds muffled, as if he had a permanent head cold. The characteristic of hyporhinolalic speech is the peculiar, so to speak, "stuffed" enunciation of the three nasal sounds of the English language, the "m," "n," and "ng."[2]

Hyporhinolalia is not only symptomatic of a head cold but may also be evidence of a number of pathologic conditions, all of which obstruct nasal breathing, such as hypertrophic adenoids, tumors in the nasopharynx, or an atresia between the velum and the posterior pharyngeal wall. Froeschels[1] and Stein[3] mention conditions of functional hyporhinolalia. These authors describe cases in which an abnormal raising of the velum during the enunciation of the "m, n, and ng" occurred; this condition followed an adenoidectomy; the previously raised velum persevered in its position. Therapy for organic hyporhinolalia, with the exception of head colds, is surgical; functional hyporhinolalia belongs to the tasks of the speech pathologist.[4]

Eventually "mixed rhinolalia," a condition in which hyper- and hyporhinolalia alternate, has to be described. In mixed rhinolalia the above-described test will be positive; air escapes through the nostrils during the enunciation of "e-oo, e-oo,"

nevertheless, the nasal sounds "m, n, and ng" will fail to manifest nasal resonance. It seems that the hyper-rhinolalia of the vowels and the hyporhinolalia of "m, n, and ng," have different points of resonance in the nasopharynx; otherwise both conditions could not be present simultaneously. Mixed rhinolalia may even be observed in patients with palatal insufficiencies, defects, or clefts. These are cases where, in spite of the dominant hyper-rhinolalia of the vowels, "m, n, and ng" sounded muffled or stuffed. Close examination revealed hyperplasia of the oropharyngeal lymphoid tissues. The hyper-rhinolalia of the vowels was caused by air escaping through the inferior meatus.[2] The variety of the therapeutic procedures to be chosen from for the three types of rhinolalia underscores the complexity of the problems. Some remarks about the physiology and anatomy of the muscle groups involved might be warranted.

### Morphology and Physiology of the Oronasopharynx

The shape of the facial and pharyngeal parts of the skull and head are determined by the functions of smell, respiration, and mastication. During its evolution, the face of the human embryo undergoes three distinct stages[5]: (1) a piscine stage, in which the nose and mouth are formed independently; (2) an amphibian stage, where the nasal respiratory passage opens on the roof of the mouth, and (3) a mammalian stage, in which it opens in the nasopharynx. The pharynx, originally a respiratory structure, becomes modified to mastication and swallowing. The tongue becomes differentiated from parts in the floor of the pharynx, and muscles, which were at first designed to move a fish's branchial arches, become converted into muscles of deglution.

In the fourth week the human pharynx closely resembles that of a fish. In the human embryo (and the fish) the pharynx is bounded by visceral or branchial arches separated by depressions. Four visceral arches may be recognized on each side of the pharynx of the fifth-week human embryo. The pharyngeal lining membrane is identical with that of the alimentary canal. From the latter derive all the organs and glands of digestion and assimilation.

The first visceral arch is known as the mandibular arch. It is the foremost of the visceral arches which encircle the walls of the primitive pharynx. Meckel's cartilage forms its skeletal basis. Formed from this arch are the lower jaw, the soft parts over and under the jaw, the lower lip, the muscles of mastication, the mylohyoid and anterior belly of the digastric, *the tensor tympani, and the tensor palati.*† *The mandibular* and the second, or hyoid, arch, both contribute to the formation of the anterior two-thirds of the tongue and of the sublingual and submaxillary glands. Its supplying nerve is the third division of the fifth cranial nerve. During the evolution of the mandible, Meckel's cartilage disappears. The malleus represents the upper end of Meckel's cartilage, whereas the incus represents the cranial articular base; peculiar as it seems, the stapes is developed from the upper end of the second, or hyoid, arch.

All the muscles supplied by the facial nerve—platysma, muscles of expression, stapedius, stylo, stylohyoid, posterior belly of the digastric, etc.—are derived from the muscle plate of the second, or hyoid, arch. The stylopharyngeus is derived from the third arch; its nerve is the glossopharyngeal. The third and fourth arches contribute to the muscles of the soft palate and the constrictors of the pharynx. The roof and posterior wall of the Eustachian tube too belongs to the formation of the third arch. Both epiglottis and thyroid cartilage arise from the fourth visceral arch. The superior laryngeal branch of the vagus is the nerve of the fourth arch; hence it supplies the epiglottis and the upper part of the larynx. Both epiglottis and palate are peculiar to mammals; thus the respiratory

† The morphologic connection between the tensor tympani and tensor palati will be discussed later.

passage is separated from the mouth. In all mammals, with the exception of man, the epiglottic lies within the nasopharynx in contact with the soft palate; with the acquisition of speech in the human this relationship has been lost. Significant deductions concerning the function of the well-developed oronasopharynx in the adult can be drawn from its embryonic evolution; the role the different muscle groups will play in mastication, respiration, and voice and speech is superimposed on these two original tasks.[6]

One has to keep in mind that, except for "m, n, and ng," the enunciation of English speech sounds requires a closure between oro- and nasopharynx. A septum formation separating the oral from the nasal cavities is a *sine qua non* for speech devoid of hyper-rhinolalia. Such a closure is obtained by action of the tensor palati and the levator palati—the muscles of the soft palate—which, during enunciation synchronously coordinate with a muscle group of the pharyngeal wall—the Passavant ridge—part of the superior constrictor pharyngis.[2] The three constrictor muscles of the pharynx and the levator palati derive, as previously mentioned, from the third and fourth embryonic arches; thus their innervation should come through the glossopharyngeus and the superior laryngeal branch of the vagus.

The function of the levator palati can best be observed on the living person. During contraction the soft palate not only is raised[7] but its free margin is simultaneously pulled toward the spinal column, thus achieving the firm septum between the oro- and nasopharynx. According to C. A. Keogh,[8] the contraction and relaxation of the levator muscles is not limited to the movements of the palate, but, with assistance of the tensors and salpingopharyngeus muscles, they bring about the opening and closing of the Eustachian tube. In Keogh's opinion, the suction action, brought about by the contraction and relaxation of the levators, helps to drain the Eustachian tube of its mucous secretions.‡ According to W. H. Hollingshead,[9] the tensor palatini may possibly be regarded as the muscles closing the Eustachian tubes. The pterygoid nerve (the tensor veli palatine), consisting of efferent motor fibers of the trigeminal nerve, innervates the tensor palati. The palatoglossus muscle in the anterior pillar and the palatopharyngeus muscles in the posterior pillar draw the palate downward; their motor innervation is supplied through the vagus and the cranial portion of the accessory.

H. C. Elliott[10] regards the motor components of the trigeminus as being also the innervator for the tensor tympani, whereas the stapedius muscle attached to the stapes is innervated through the facialis. A number of authors speculate[11,12] whether there exists an anatomic relationship between the veli palatini and the tensor tympani. S. Romano[13] speaks of a biventer muscle; he proves that this connection is even more apparent in the fetus and believes in common function of the two muscles, their common innervator being the trigeminus. Another branch of the facialis innervates the digastric muscle, the muscle which retracts and elevates the tongue and the hyoid bone, whereas the intrinsic and extrinsic muscles of the tongue per se, with exception of the palatoglossus, are innervated through the hypoglossal nerve.

The neuromuscular interdependence of the speech apparatus is the reason why hyper-rhinolalia may be caused by a variety of organic pathologic conditions, which it will be my next task to investigate in this paper.

### What Causes Hyper-Rhinolalia?

Let us keep in mind that hyper-rhinolalic speech is diagnosed whenever the palate does not serve its function of closing off the oropharynx from the nasopharynx so that during enunciation air escapes through the nasal passages.

‡ At a later point in this paper, I shall discuss the consequences of the physiologic relationship between soft palate and Eustachian tube.

The symptoms of hyper-rhinolalia, regurgitation of fluids through the nose, and swallowing difficulties accompany all those forms of polyneuritis which cause lesions limited to the upper part of the nucleus ambiguus and are associated with paralysis of the soft palate and the pharynx.[14] Hyper-rhinolalia may be secondary to acute infections, such as diphtheria or poliomyelitis. It may be caused by degenerative diseases of the central nervous system.[14]

Congenital or traumatic defects or malformation of the palate varying in degree and size cause hyper-rhinolalia. Hyper-rhinolalia follows in the wake of traumatic perforation of the hard and soft palate. It is caused by any destructive disease, such as syphilitic gummata, carcinoma, or tuberculosis of the palate.[1]

Traumatization of the ridge of Passavant[15] during removal of adenoids and lymphoid tissue from the pharyngeal wall, which postoperatively makes it impossible for the patient to close off his nasopharynx, produces hyper-rhinolalia.

H. S. Vaughan[16,17] describes those cases of hyper-rhinolalia which need a thorough evaluation of the palate with the view of discovering the latter's insufficiency or defect. One may detect deficiencies such as the following ones:

1. A congenital short hard palate; the soft palate may be normal in appearance; sometimes the uvula may be bifid.
2. The entire soft palate may be thin and membranous, with general lack of muscular development.
3. The mucoperiosteum may be thin over a hard palate of normal length, with a submucous cleft through the soft palate.
4. There may be a submucous V-shaped cleft existing in the bone of the hard palate, with a thin soft palate.

It frequently happens that in these congenital deformities of the palate the tonsils or adenoidal tissue serve as pillars or as a bridge in the nasopharyngeal cavity, preventing air from escaping through the nasal passages. Hyper-rhinolalia will become manifest as soon as these obstacles are removed. To exclude any unpleasant surprise, the throat specialist, before performing surgery, is advised to glide his forefinger along the midline of the palate, starting at the alveolar ridge, in order to ascertain whether the palatal formation is intact. If any deficiencies are detected, tonsillectomy and/or adenoidectomy will aggravate the hyper-rhinolalia.[1] In such a case, the surgeon should inform the patient and his family of this eventuality and discuss the patient's speech as the problem at issue. In general, the removal of tonsils and adenoids in cases of palatal insufficiency[16] is not advisable. The scar contraction of the posterior and lateral pharyngeal wall prevents the development and action of the pterygopharyngeus portions of the superior constrictor and leaves a pharynx of greater anteroposterior and lateral diameter.

If, for medical reasons, however, surgery is indicated and thereafter hyper-rhinolalia distorts the patient's speech, logopedic therapy will be advocated as ultimate resort.[1]

For the correction of more extended deformities, such as congenital clefts of the palate, many different palate operations have been suggested and described by different authors.[18] All these procedures, however, may be grouped into two main categories[16]: (1) operations for closure of the cleft and (2) operations for lengthening of the palate.[2] Surgery for lengthening of the palate, such as the Dorrance[18] pushback operation, or techniques which combine the pushback with the pharyngeal flap surgery[19] are procedures which aim to eradicate hyper-rhinolalia.

The important considerations to be made for this kind of surgery are conservation of the blood supply and relief of tension. The prosthodontist may be needed, besides the plastic surgeon and the speech therapist, to construct speech appliances for those cases in which velopharyngeal insufficiency exists after surgery has reached its limits, for cases of surgical failure with loss of available tissue and for those unusual cases where lack of tissue contraindicates surgical interference.[16]

Froeschels made available a special prosthodontic appliance [20] for correction of the hyper-rhinolalia.[21] He suggests its usage in those cases where speech exercises proved to be futile. The construction of his appliance is based on the observation that certain cases showed no or only negligible hyper-rhinolalia in spite of having a congenital cleft or a paralyzed velum. Among all these specific patients swollen posterior ends of the turbinates could be diagnosed. It was this latter condition which prevented the air from entering into the meatus.[22] On the basis of his findings, Froeschels concluded that hyper-rhinolalia may have its origin in some resonance conditions inherent in the meatuses.§ In cooperation with A. Shallit he constructed a meatobturator [23] which not only successfully obliterates the hyper-rhinolalia but also permits nasal breathing, in contrast to former types of obturators.

### Hyper-Rhinolalia and Hearing

In medicine, deficiencies of any kind rarely appear as isolated phenomena; they are usually associated with other problems, problems which for one reason or the other may be closely interconnected, interdependent, or related to each other. Such is the case with hyper-rhinolalia caused by palatal insufficiencies. Thus it has been observed that persons born with defects of the palate suffer a loss of hearing acuity. A series of investigations have been made as to the why of the hearing loss, and many hypotheses have been expressed as to the coincidence of these two factors.

In their study, J. Sataloff and M. Fraser [24] indicate that in cases of palatal clefts it is the exposed condition of the Eustachian tube which carries in its wake infections from food, trauma, and inadequate aeration. These authors, in addition, express the opinion that it is not so much the presence of infections in the ear as it is the disparity of pressures between the outside and the middle ear which result in the considerable difficulty these patients have in early infancy aerating their middle ears—"along with the abnormal exposure of the Eustachian orifice" [24] which "tends to facilitate early insidious hearing loss without subjective symptoms." As one of the results of their investigation and following suggestions of Dr. G. M. Coates, the authors discuss the advisability of performing careful adenoidectomies in children with cleft palates before the closure of the palate. They ventilate the question whether such early surgery might not be justified in order to prevent ear complications and avoid nasal obstruction due to hypertrophied adenoids. An adenoidectomy performed as long as the palate is open is certainly easier and safer than if by necessity one has to operate without visualization of the nasopharynx owing to the inability to retract the repaired palate. The authors indicate that this procedure would probably have no harmful effect on speech.

In the past, it has been surmised that the ears of patients with palatal clefts are subjected to many and repeated infections; each time such a person swallows, potentially infected food may pass or even be driven into the Eustachian tubes. Early closure of the palate could be expected to prevent hearing loss. Observations and conclusions of E. M. Holmes and G. F. Reed [25] do not bear this out. They state that, in spite of closure at an early age, the nasopharynx continues to be subjected to more trauma, pathology, and infection than is the case in the nasopharynx in children with normal palates. No prevention of the hearing loss can be obtained by performing tonsillectomies or adenoidectomies; no relationship has been discovered between the hearing loss and the presence or absence of tonsils or of an abnormal amount of adenoid tissue. Both authors suggest,[25] as the best means to prevent hearing loss, a prompt recognition and treatment of the disease process "before there is a chance for organization of undrained, purulent or serous debris in the middle ear." [25]

§ See first section of this article.

A very thorough audiologic and otorhinologic investigation of cleft-lip and cleft-palate patients was made by M. M. Halfond and J. J. Ballenger.[26] Besides formulating a series of important research problems, the question was raised as to the conditions existing in the Eustachian tubes and whether any structural deviations peculiar to cleft-lip and cleft-palate persons might be related to the deficient hearing acuity? Their data imply that dysfunction of the Eustachian tube—tubal stenosis as well as abnormal tubal patency—and small Eustachian tube orifices should be related to hearing loss.

According to Halfond and Ballenger, "The only direct source of infection found to be related to hearing loss was tonsillar pathology." Accordingly, it may be assumed that the infection of the tonsils establishes the kernel for the middle ear inflammation; it is then that the dysfunction of the Eustachian tube tends to perpetuate the inflammation.[26] As to the etiology of this dysfunction, the authors point at the morphological relationship between the development of the palate and the Eustachian tube. They suggest that failure in the union of the palatal plates may have its concomitant effects on adjacent structures and thus alter the growth of the Eustachian tube or the ear. The loss of hearing acuity and the occurrence of infections in the middle ear among cleft-palate persons may thus have its origin in structural deviations in the Eustachian tube and middle ear and might, besides, include the pharynx and nasal structures.[26]

Sataloff and Fraser as well as Halfond and Ballenger are convinced that inadequate function of the Eustachian orifice is part of the pathologic characteristics of the cleft-palate patients. It is this inadequate function which carries in its wake middle ear inflammation and thus represents an ever-present danger for loss of hearing acuity. These conclusions are logical deductions, since the Eustachian tube has no independent muscle apparatus, its three muscles being the tensor veli palatini, the levator palatini, and to some extent the pharyngotubalis.[7] The two first muscles form an integral part of the muscles of the palate; no intensive movement of the Eustachian tube can be obtained without a simultaneous movement of the palate[8]; in congenital shortening of the palate in association with cleft it is obvious that the palatal muscles cannot be raised and thus cannot perform their combined task of acting synchronously on the isthmus faucium and on the Eustachian tube. Among the consequences of this lack of function are the hyper-rhinolalia and failure in aeration and draining of the tube.

The interdependence between the palatal muscles and the hearing apparatus may manifest itself on still another level. The close relationship between the tensor veli palatini and the tensor tympani (considered as being a biventor muscle with a common function[13]) may become evident in the function of the tensor tympani as an accommodation muscle; as such it regulates the tension of the ear drum. Depending on whether strong or weak sounds meet the ear, the muscle relaxes or intensifies the tension of the drum. It functions as the synchronous antagonist of the stapedius muscle, which for the purpose of sound attenuation retracts and thus pulls the stapes out of the oval window.[27] ‖

The question which presents itself is the following: Can we assume that the sound accommodation mechanism executed by means of the tensor tympani might be impaired among cleft-palate persons equipped *de rigueur* with deficient tensor veli palatini? As far as we are informed, the incident of hearing loss among cleft-palate persons has not been investigated from this viewpoint; a number of careful studies have appeared in print[28-31] about the function of the tensor tympani and the stapedius muscle among normal persons.

‖ A more detailed discussion of the physiology of hearing would go far beyond the scope of our present investigation.

Some investigations, which surmise possible structural deviations in the middle ear among their cleft-palate population [26] and prove the hearing impairment to be of the conductive type, point in the direction of our assumption. It may explain why a certain number of cleft-palate patients present a hearing loss without any detectable previous middle ear infection. The function or nonfunction of the attenuation mechanism of the tensor tympani among a cleft-palate population could be an interesting subject for a doctoral dissertation.

Presently, however, our interest is confined to observations on hyper-rhinolalia, and too much changing off from the subject has to be avoided for the sake of clarity. In the future it may be we shall have the opportunity to follow up some of the leads and look closer into some interconnections of phenomena which so far have been considered as separated problems.

The next and last part of our paper will describe some therapeutic experiences with patients afflicted with hyper-rhinolalia, yet excluding those cases where the hyper-rhinolalia was the consequence of a cleft and/or congenital shortening of the palate.[2]

## Therapy

When, in the fall of 1948, the city of New York was ravaged by a severe epidemic of poliomyelitis, one of the hospitals where I work as speech pathologist had a pavilion reserved for the treatment of the disease.

During this period a little 11-year-old girl, who was convalescing from a comparatively light attack of bulbar polio, was referred for speech therapy. According to her case history, the only remaining symptoms were a slight weakness of the left foot (the heel tendon), marked hyper-rhinolalia, and swallowing difficulties. Her diet consisted of liquid food only. The child's mother was especially concerned about the speech defect.

On closer examination, the following observations were made: no middle ear infection; tonsils and adenoids removed; teeth in good condition and developed according to the age of the child; normal mobility of the tongue. The patient had *not* undergone a tracheotomy; neither could any abnormal contraction of the cricopharyngeus muscle be observed. There was no shortening or any kind of cleft of the palate. The child's velum did not move; the uvula continued to touch the tongue when she was told to say "a" (as in arm). The vowels were distorted by hyper-rhinolalia; the enunciation of "b" and "d" could not be differentiated from "m" and "n," respectively. The "ee-oo, ee-oo, ee-oo" test ¶ was positive.

The classic therapy for obtaining upward movements of the soft palate is the pushing exercises [2] based on the principle that when one set of muscles is pulled in one direction another set automatically compensates by moving in the opposite direction.[1] When, in the course of the examination of the child's mouth, I touched her uvula with a tongue depressor and unexpectedly evoked a gagging reflex, I took it as evidence that her cranial nerves had recuperated more than her swallowing difficulties and her hyper-rhinolalia had permitted us to anticipate. During this incident the patient's soft palate moved rapidly upward and backward toward the pharyngeal wall. Observing carefully, I then deliberately touched her pharyngeal wall and thus got an even stronger reaction of the muscles involved. This palatal and pharyngeal muscular response suggested the idea of utilizing it as means for therapy.

Equipped with tongue depressor, flashlight, and mirror, I explained to the patient why I wanted her to gag, the gagging being instrumental in raising her palate; it was this latter movement which constituted the remedy for her nasal twang. She was asked to gag as strongly as possible emitting each time a little "a" sound, as if she were to vomit. She was told to practice "gagging" 12 times each day, resting, however, for two hours after each meal.

At the next appointment, two days later, her mother spontaneously remarked, "Peggy's ability to swallow has much improved." A number of soft foods had been added to her diet, the dietitian having promised puréed meat in the near future. The good news—that the patient's function of swallowing might benefit from the exercises was not unexpected—presented an important adjunct to our therapeutic endeavors.

Additional motivation, facilitated deglutition, contributed to induce the child to practice her exercises, and soon, with the help of the mirror, I could proceed in training the child to try to raise her soft palate, without the stimulation of the tongue depressor, by just thinking, "Gag." Ten days later, the palatal muscles worked so well that we combined with these exercises the enunciation of the vowels. It was during this last period that her spontaneous speech lost its hyper-rhinolalic characteristic. Eventually, after three weeks of therapy, the child was able to swallow chopped meat. On a follow-up visit, six months later, her

¶ See the beginning of this paper for description of the test.

speech as well as her swallowing capacity was satisfactory to everybody concerned.

An obvious argument against this case history might be whether you can prove that this patient's speech and deglutition would not have recovered spontaneously, without any exercises. In this specific case the answer is that I cannot! Research, however, has evidenced that a large part of the deformities caused by poliomyelitis may be prevented and a great deal of rehabilitation may be obtained by early adequate nursing care, orthopedic measures to protect against deformities, and physical training to help *restore muscle function.*[32] The main reason for quoting this case history is that a method of active, voluntary, conscious exercises of muscles of the palate was introduced as therapy, a technique which, according to my experience, seems to assure quicker and better results than the one based on compensation principles.[2]

Since 1948, I have treated 12 patients by this method, patients who suffered from hyper-rhinolalia and complained of swallowing difficulties. These afflictions were diagnosed as originating from central lesions caused by previous diseases which had damaged the central nervous system. Some of these patients were seen 6 to 18 months after the onset of the original illness, some two years later. The previously described case was the only one who received treatment while still in the hospital.

It was not the hyper-rhinolalia or their difficulty with swallowing that had compelled these patients to seek treatment; they had accepted these very infirmities as inevitable residue of their former disease. They came to the E. N. T. clinic because they were frightened by middle ear infection, chronic discharge, and evidence of diminished hearing acuity. How could they have been aware of the fact that their ear infection developed in the wake of their palatal paralysis, a paralysis which includes the muscle synergies of the Eustachian tube [7] and thus prevents the latter from carrying out its function of drainage and aeration? The E. N. T. specialist who took care of the infection eventually referred these patients for therapy at the speech clinic.

None of those patients referred to the speech clinic had undergone tracheotomy; none had an abnormal contraction of the cricopharyngeus muscle, although all of them complained of marked difficulties while swallowing food.

"Since I had polio, two years ago," confessed one patient, a woman of 32, "each meal is an ordeal for me. I can swallow only soft food, and, even then, I have to be very careful to take tiny bites; otherwise the food might get stuck in my throat, and then I get coughing spells. Each bite I have to wash down with water; yet I have to recline my head when I swallow for fear the liquid might escape through my nose. I dare not go to a restaurant or have guests at home, although entertaining is necessary for the business of my husband."

The therapy in this case, as in all of our other cases, consisted of provoking the "gag" reflex by touching the pharyngeal wall with a tongue depressor in order to obtain contractions of the levator palati muscles. During the first sessions I pushed her soft palate upward, telling the patient to try to hold it in this position. Breathing exercises [33] were introduced in order to strengthen those muscular synergies necessary for speech and voice production. Later on I applied breathing therapy for all my patients. The reason for all these exercises was not only to counteract atrophy and if possible to restore lost function but also to make an otherwise unconscious function conscious and controlled. I had to admire the stubborn energy and persistence with which the patient continued to practice in order to achieve her goal. She came to the clinic twice a week for six months. One day she arrived radiant, with a big box of candy as a gift for us. She had succeeded in eating in a restaurant, in the company of her husband and friends, without any outward sign of distress. Two months later, she asked to discontinue her regular visits to the clinic. Her middle ear infection had been cured, and her eating problem ceased to be; her request was granted, although her hyper-rhinolalia was not completely eliminated.

The exercises introduced to counteract palatal paralysis might best be compared with those therapeutic procedures devised for restoring an incapacitated limb in an institute for rehabilitation and physical medicine. There is, however, one essential difference; with an arm or leg one performs conscious voluntary movements, whereas in

normal, ordinary circumstances one is not aware that the soft palate performs any movements during the function of speech or deglutition; it is one of the methods of therapy to make the patient conscious of these movements so that he may learn to perform them voluntarily.

There was a definite relationship in all cases treated between the duration of treatment, the results obtained, and the period of time that had elapsed since the onset of the original illness. The shorter the period, the quicker and better the results. Deglutition greatly improved among all our patients; speech however, remained slightly rhinolalic # in those cases where more than a year passed before treatment was initiated. This incongruity in improvement attained might indicate that the palatopharyngeal muscle synergies for speech or for the function of deglutition are *not* of completely identical nature. A comparison of x-ray motion pictures made during both actions by the same person might clarify this question.

In view of my observations, I may be permitted to assume that the nerve pathways of the pharyngeal plexus which have been damaged by disease are restored to function by techniques of muscle reeducation in those patients in whom the gag reflex could be elicited.[14,34]

The above-described experiences suggest the conclusion that patients who, as a consequence of lower motor neuron lesions, suffer a paralysis of the palatopharyngeal muscles would benefit from the therapy presented here, a treatment originally devised for the elimination of hyper-rhinolalia, which, however, proved in addition, to act as antidote for a number of complications following *de rigueur* in the wake of palatal paralysis.

## Summary

In this paper, the medical aspects of the symptom of hyper-rhinolalia are investigated. A method by which a fool-proof differential diagnosis between hypo- and hyper-rhinolalia can be ascertained is described.

When hypo- and hyper-rhinolalia are present simultaneously in the same patient one speaks of mixed rhinolalia, a condition caused by the fact that the hyper-rhinolalia of the vowels and the hyporhinolalia of the "m, n, and ng" are produced at different resonance points in the nasopharynx.

In order to secure a better understanding of the problems involved, I chose to take the morphology and physiology of the oronasopharynx into consideration.

The neuromuscular interdependence of the vocal and speech mechanism is the reason why hyper-rhinolalia may be caused by various organic pathologic conditions.

Once the diagnosis of hyper-rhinolalia is made, it always means that for one reason or the other the palate does not serve its function; a thorough examination has to detect the insufficiency or hidden defect. Hyper-rhinolalia, however, rarely appears as an isolated phenomenon; one of the symptoms it may be linked to is loss of hearing. The why of the coincidence of these two defects is investigated; opinions of different authors are quoted in order to clarify the problem. The prevailing theory is expressed as follows: In cases of palatal insufficiency the combined muscles of the palate fail in their task of acting synchronously on the isthmus faucium and on the Eustachian tube. This inadequate function, the failure in aeration and draining of the tube, is followed by middle ear inflammation and thus becomes an ever-present hazard for loss of hearing acuity.

The last part of the paper is concerned with therapy. Two case histories describe treatment of hyper-rhinolalia secondary to poliomyelitis. A method of active, conscious reeducation of the muscle synergies involved is discussed.

444 E. 58th St. (22).

## REFERENCES

1. Froeschels, E.: Nose and Nasality, A. M. A. Arch. Otolaryng. 66:629-633, 1957.

# The tube test remained positive.

2. Freud, E. D.: Speech Rehabilitation of Patients with Cleft Palate, Arch. Otolaryn. 51:685-695, 1950.

3. Stein, L.: Sprach- und Stimmstörungen und ihre Behandlung in der täglichen Praxis, Wien, Verlag für Medizin, Weidmann & Co., 1936, pp. 106-125.

4. Morley, M. E.: Cleft Palate and Speech, Edinburgh, E. & S. Livingstone, Ltd., 1945.

5. Keith, A.: Human Embryology and Morphology, London, Edward Arnold & Co., 1921.

6. Freud, E. D.: Voice and Breathing, A. M. A. Arch. Otolaryng. 67:1-7, 1958.

7. Zöllner F.: Anatomie, Physiologie, Pathologie und Klinik der Ohrtrompete und ihre diagnostisch therapeutischen Beziehungen zu allen Nachbarschafts-erkrankungen Berlin, Springer-Verlag, 1942.

8. Keogh, C. A.: The Neurology and Function of the Pharynx and Its Powers of Compensation in Paralysis, Ann. Otol. Rhin. & Laryng. 66:416-439, 1957.

9. Hollingshead, W. H.: Anatomy for Surgeons, New York, Paul B. Hoeber, Inc. (medical book department of Harper & Brothers), 1954.

10. Elliott, H. C.: The Nervous System, Philadelphia, J. B. Lippincott Company, 1947.

11. Tröltsch, V.: Beitrag zur anatomisch-physiologischen Wirkung der Gaumenmuskulatur, Arch. Ohren- Nasen- u. Kehlkopfh. 1:15, 1864.

12. Mayer, L.: Studien über die Anatomie des Canalis Eustachii, München, 1866 quoted from F. Zöllner.[7]

13. Romano, S.: Rilievo di anatomia descittiva e topografica del musculo timpano-salpingo-stafilino nell'uomo, Valsalva 2:506, 1926.

14. Brain, W. R.: Diseases of the Nervous System, London, Oxford University Press, 1951.

15. Barton, R. T.: The Clinical Significance of the Ridge of Passavant, Surg. Gynec. & Obst. 101:317-320, 1955.

16. Vaughan, H. S.: Surgical Repair of Cleft Palate with Special Reference to Lengthening the Soft Palate, Am. J. Surg. 31:5-6, 1936.

17. Vaughan, H. S.: Congenital Cleft Lip, Cleft Palate and Associate Nasal Deformities, Philadelphia, Lea & Febiger, 1940.

18. Dorrance, G. M.: The Operative Story of Cleft Palate, Philadephia, W. B. Saunders Company, 1933.

19. Conway, H., and Stark, R. B.: Pharyngeal Flap Procedure in the Management of Complicated Cases of Cleft Palate, Ann. Surg. 142:662-673, 1955.

20. Froeschels, E.: Speech Therapy, Boston, Expression Co., 1933, p. 1941.

21. Sharry, J. J.: The Meatus Obturator in Cleft Palate Prothesis, Oral Surg. 7:852-855, 1954.

22. Froeschels, E., and Jellinek, A.: Practice of Voice and Speech Therapy, Boston, Expression Co., 1941, pp. 158-166.

23. Schalit, A.: Obturator of Choice for Congenital Cleft Palate, Am. J. Orthodontics (Oral Surgery Sect.) 32:688-713, 1946.

24. Sataloff, J., and Fraser, M.: Hearing Loss in Children with Cleft Palate, A. M. A. Arch. Otolaryng. 55:61-64, 1952.

25. Holmes, E. M., and Reed, G. F.: Hearing and Deafness in Cleft-Palate Patients, A. M. A. Arch. Otolaryng. 62:620-624, 1955.

26. Halfond, M. M., and Ballenger, J. J.: An Audiologic Evaluation and Otorhinologic Study of Cleft-Lip and Cleft-Palate Cases, A. M. A. Arch. Otolaryng. 64:58-62 and 335-340, 1956.

27. Vermes, E.: Personal communication to the author.

28. Hallpike, C. S.: On the Function of the Tympanic Muscles, Proc. Roy. Soc. Med. 28:226, 1935.

29. Hallpike, C. S., and Smith, R. A. F.: The Function of the Tensor Tympani Muscle, J. Physiol. 81:25, 1934.

30. Kobrak, H. G.; Lindsay, J. R., and Perlman, H. B.: Value of the Reflex Contraction of the Muscles of the Middle Ear as an Indicator of Hearing, Arch Otolaryng. 21:663-676, 1935.

31. Wever, E. G., and Bray C. W.: The Tensor Tympani Muscle and Its Relation to Sound Conduction, Ann. Otol. Rhin. & Laryng. 46:947-961, 1937.

32. Ober, R. F.: Handbook of Physical Medicine and Rehabilitation, New York, The Blakiston Company (division of McGraw-Hill Book Company, Inc.), 1950.

33. Hofbauer, L.: Atemregelung als Heilmittel, Wien, Verlag für Medizinische Wissenschaften, Wilhelm Maudrich, 1948.

34. Merritt, H. H.: A Textbook of Neurology, Philadephia, Lea & Febiger, 1955.

# A New Approach to Surgery of the Lower Cartilaginous Vault

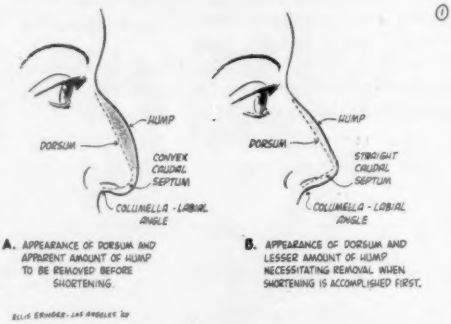
EDWARD M. LIPSETT, M.D., Beverly Hills, Calif.

The new surgical concept and technique which I am presenting, is simple, rapid, and highly satisfactory in all types of deformities of the lower cartilaginous vault. In my experience it yields the greatest latitude for the best anatomic, physiologic, and harmonious configuration. Before describing this technique, it should be borne in mind that the sequence of the surgical procedures is of utmost importance for the proper correction of the deformities involved.

Assuming that local infiltration and elevation of the soft structures have been completed with transfixion down to the nasal spine, the upper lateral cartilages are then freed from their attachments to the septum, thus avoiding trauma to them when surgery is performed on the dorsum.

Shortening of the nose with the establishment of an approximate columella-labial angle is then completed prior to any surgery on the dorsum. The resulting release of the tip following this procedure allows it to spring upward and backward, thus revealing the true height of the dome and its relation to the cartilaginous dorsum. Should the procedure be reversed and the hump removed, or the dropping of the dorsum be performed before shortening, it may be found that too much dorsum has been removed, thereby creating forthwith surgical problems and the probability of undesirable esthetic results. The amount of shortening and the degree of the columella-labial angle should vary according to the age, sex, height, personality, and configuration of the face of the patient plus the texture and tone of the skin of the lower third of the nose. It must be realized that the experience and esthetic concept of the surgeon are most important and that every nose has its anatomic and esthetic limitations. In general, the nose should be brought into artistic relationship to the other features of the face. In many cases the anterior nasal spine will not require reduction, but when the situation calls for correction of the spine, its normal relationship to the caudal septum must always be maintained. The caudal margin of the septum should be straight and the mucous membrane flush with the margin. Careful attention to these details will provide for better insurance against postoperative deformation of the nasolabial configuration (Fig. 1).

The dorsum is then corrected according to the anatomic and esthetic demands, and the necessary osteotomies are performed. The instruments a surgeon prefers to carry out these procedures are not important so long as he has control and mastery over them. Complete osteotomies and mobilization and realignment of the bony segments are most important in order to avoid the




A. APPEARANCE OF DORSUM AND APPARENT AMOUNT OF HUMP TO BE REMOVED BEFORE SHORTENING.

B. APPEARANCE OF DORSUM AND LESSER AMOUNT OF HUMP NECESSITATING REMOVAL WHEN SHORTENING IS ACCOMPLISHED FIRST.

ELLIS ERMOGER - LOS ANGELES '58

Figure 1

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often observed postoperative separations, widening, thickenings, and deviations of the bony framework.

After the completion of the surgical procedures already mentioned, the lower cartilaginous vault is then rotated upward and backward on the septolabial angle fulcrum and the columella sutured to the septum. Thus the cartilaginous vault is fixed, establishing the approximate relationships of the height of the dome to the dorsum, and the lower laterals to the upper lateral cartilages.

One of the most important considerations in the prevention of the frequently seen rounded lower third of the nose is the relationship of the height of the dome to the dorsum. In all cases, the dome should be on a higher plane, the degree varying with the texture and tone of the skin of the lower third. Here experience is very important in projecting the appearance of the nose several months postoperatively, because the surgeon must anticipate the approximate extent of future fibrous tissue formation and thickening of the skin. This is accomplished by lowering the cartilaginous dorsum to compensate for this undesirable reaction to surgery. Even with considerable experience and mature judgment, one is obliged occasionally to revise the lower third of the nose at a later date (Figs. 2 and 3).

Because of the extensive dissection and mobilization of the lower lateral cartilages required by the new technique described below, correction of the upper lateral cartilages is performed prior to surgery on the lower laterals. The upper laterals are reduced to the level of the septum without overriding it and shortened down to the cephalic margin of the lower laterals without gapping or overlapping. By bringing the lower lateral cartilages into relationship to the upper laterals rather than the usual procedure of bringing the upper laterals into relationship to the lower laterals, surgery in this area is simplified and the results better controlled (Fig. 4).

Correction of the lower cartilaginous vault in height, width, form, or direction is the final surgical procedure. A circumferential alar rim incision is made extending from a variable point in the columella to within a short distance anterior to the base of the naris. The overlying skin and soft tissues are undermined throughout the extent of this rim incision by means of a curved double-edged serrated scissors. It is very important that the dissection should extend into the inferior fibrous attachment of the lateral crus. If this is not accom-

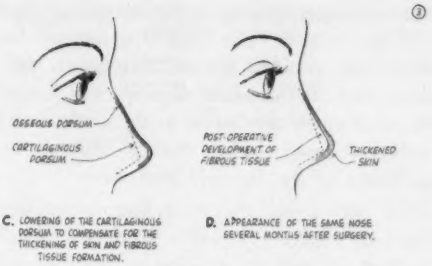
OSSEOUS DORSUM
CARTILAGINOUS DORSUM
POST-OPERATIVE DEVELOPMENT OF FIBROUS TISSUE
THICKENED SKIN
C. LOWERING OF THE CARTILAGINOUS DORSUM TO COMPENSATE FOR THE THICKENING OF SKIN AND FIBROUS TISSUE FORMATION.
D. APPEARANCE OF THE SAME NOSE SEVERAL MONTHS AFTER SURGERY.

Figure 3

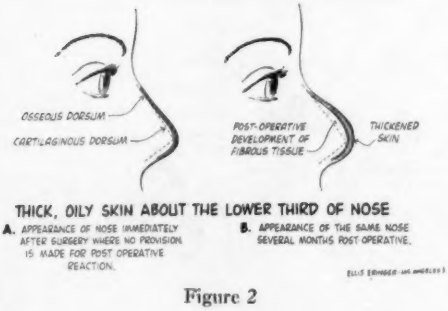
OSSEOUS DORSUM
CARTILAGINOUS DORSUM
POST-OPERATIVE DEVELOPMENT OF FIBROUS TISSUE
THICKENED SKIN
THICK, OILY SKIN ABOUT THE LOWER THIRD OF NOSE
A. APPEARANCE OF NOSE IMMEDIATELY AFTER SURGERY WHERE NO PROVISION IS MADE FOR POST OPERATIVE REACTION.
B. APPEARANCE OF THE SAME NOSE SEVERAL MONTHS POST OPERATIVE.

Figure 2

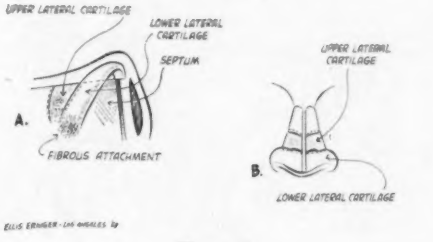


Figure 4

plished, repositioning of the lateral cartilage will be difficult. The failure to pursue the dissection into the fibrous attachment may cause deformities about the rim which may be erroneously attributed to the method and technique used, rather than to the incompleteness of the surgical procedure.

At this point the technique under discussion departs radically from the usual method of splitting the lower cartilaginous vault at the angle.

In the angle technique, the healing of the reconstructed cartilages cannot be controlled. When the angle is split and the mesial crus is subsequently attached to the septum, it frequently overrides the dorsum in an uncontrolled manner. Various contractures and adhesions may develop, giving rise to abnormal pockets and fistulae, which frequently contain a foul discharge. Deformities of the nasal lining may also occur with a resultant distortion in the anatomy and a disturbance in the physiology.

In order to avoid these unfavorable possibilities, *the splitting of the lower cartilaginous vault is made at the level of the newly created cartilaginous dorsum of the septum.*

Owing to the fact that the dome is placed at a more elevated plane than the cartilaginous dorsum, this splitting incision will always fall in the mesial crus. A chondroplastic flap is thus created, consisting of part of the mesial crus, the dome, and all of the lateral crus with the underlying skin. This flap is easily and rapidly delivered (Figs. 5, 6, and 7).

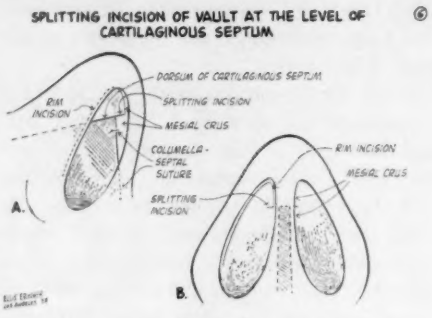


Figure 6

All adipose and fibrous tissues overlying the cartilages on the undersurface and between the free mesial crura should be cleanly removed. This aids in the reduction of bulk, lessens the likelihood of subsequent possible foci of thickenings, and allows for a more graceful draping of the skin over the cartilages. At this point, without any further surgical correction, repositioning of the chondroplastic flaps will reveal that the arches have been lowered and appear narrowed because of the greater convergence of the cartilages in the midline. If further reduction in the height of the dome is desired, it is accomplished by excising the necessary quantity of cartilage from the mesial end of the delivered chondroplastic flap.

Similarly, reduction in bulbousness may be obtained by excising the necessary amount of cartilage from the cephalic margin of the flap (Figs. 8 and 9).

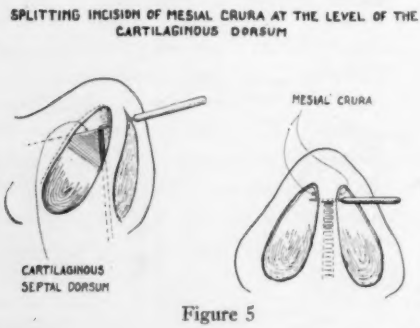
SPLITTING INCISION OF MESIAL CRURA AT THE LEVEL OF THE CARTILAGINOUS DORSUM
⑤
MESIAL CRURA
CARTILAGINOUS SEPTAL DORSUM

Figure 5

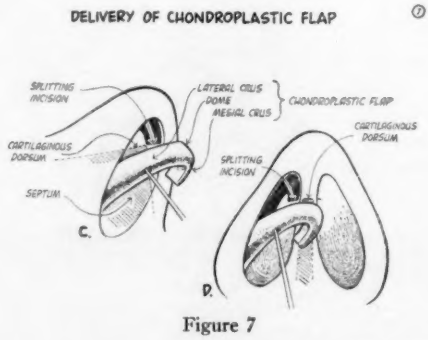


Figure 7

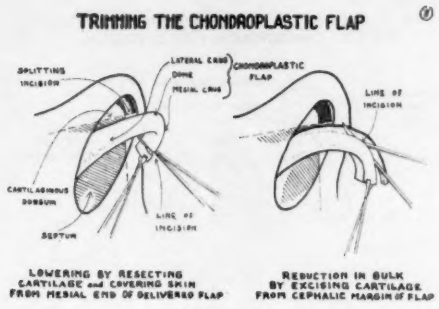


Figure 8

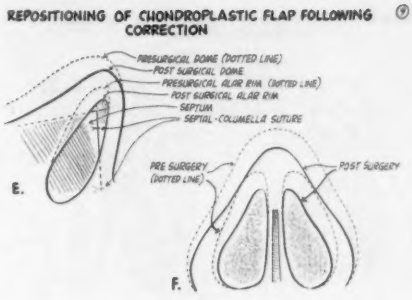


Figure 9

If it is necessary to narrow the flare of the nasal ala and to obtain more elevation of the dome, the chondroplastic flap is transfixed by an advancing suture to the rim margin. Thus the flap is maintained in its new upward and medial position.

Correction of the contour of the vault because of inharmonious dimensions and proportions is accomplished most satisfactorily by making multiple parallel vertical incisions completely through the cartilage to the underlying skin of the chondroplastic flap. These incisions may extend laterally and medially from the angle to the point dictated by the need. In this manner, the spring of the cartilage is broken, permitting the surgeon to shape a more harmonious configuration of any or all of the lower laterals. I refer to this procedure as "furrowing of the cartilage."

Furrowing is not necessary when the lower lateral cartilages are adequate; however, it is essential and effective when changes in the contour and direction of those cartilages are desired. To further illustrate the versatility and technique of this new approach, two deformities commonly seen will be discussed, i. e., the high acute-angled dome and the low broad dome.

The procedure for lowering a high acute-angled dome as described in most textbooks produces results which leave much to be desired. The technique is to amputate the acute angle by cutting through the lateral and mesial crura at the same level and then bringing the remaining stumps together. Although lowering is accomplished, the acuteness of the angle still remains, plus all the possible disadvantages of the angle method previously discussed (Fig. 10).

To overcome these difficulties, the new approach to tip surgery which I have presented has proved most satisfactory. The mesial crura are incised at the level of the dorsum of the septal cartilage and the chondroplastic flaps are delivered (Fig. 11).

The desired amount of lowering is accomplished by resecting the necessary

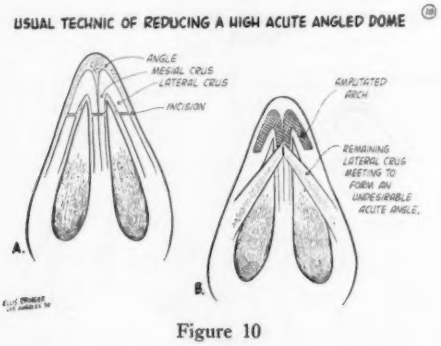


Figure 10

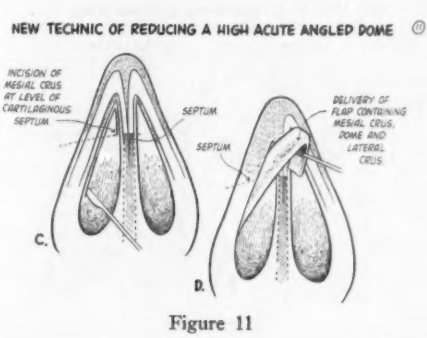
NEW TECHNIC OF REDUCING A HIGH ACUTE ANGLED DOME
INCISION OF MESIAL CRUS AT LEVEL OF CARTILAGINOUS SEPTUM
SEPTUM
C.
SEPTUM
DELIVERY OF FLAP CONTAINING MESIAL CRUS, DOME AND LATERAL CRUS
D.

Figure 11

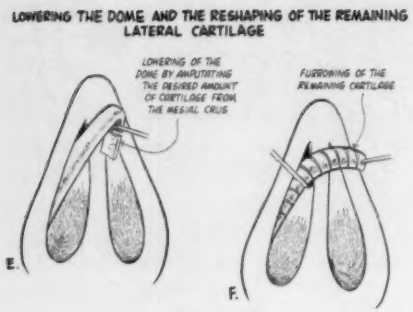
LOWERING THE DOME AND THE RESHAPING OF THE REMAINING LATERAL CARTILAGE
LOWERING OF THE DOME BY AMPUTATING THE DESIRED AMOUNT OF CARTILAGE FROM THE MESIAL CRUS
FURROWING OF THE REMAINING CARTILAGE
E.
F.

Figure 12

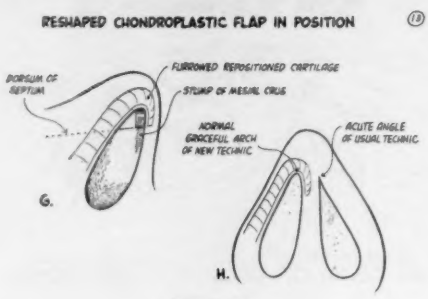


Figure 13

quantity of cartilage and covering skin from the mesial end of the delivered flaps. The remaining cartilage of the flap is completely furrowed, thus making it possible to shape a new vault. The furrowed flap is repositioned to its alar skin margin by an advancing suture. The contour of the new vault is maintained by intranasal packing and external splinting (Figs. 12 and 13).

The same basic technique is used to correct a low broad dome. The arch is split at the level of the cartilaginous dorsum, and the chondroplastic flap is delivered. After the reduction in bulk of the delivered cartilage, the remaining cartilage is furrowed (Fig. 14).

The reshaped furrowed chondroplastic flap is repositioned and fixed to the alar skin margin by an advancing suture into its new upward, inward, and medial position. Thus the broad dome has been narrowed, the height of the dome increased, and the alar flare diminished. The reshaped vault is supported by intranasal packing and external splinting (Figs. 15 and 15).

Intranasal packing is only used to give support to the reshaped vault when the spring of the lower lateral cartilage has been broken by furrowing. In the many cases when the lower lateral does not need to be furrowed, it is repositioned and fixed by a single suture to the alar skin margin, thus insuring against possible displacement and removing the need for packing.

Before the external dressing is applied, the operative areas should be carefully examined in order to determine whether all the procedures have been satisfactorily completed, and any revisions and cleaning up should be done at that time. It is well to bear in mind that sutures, splints, and external dressings are no substitutes for careful and complete surgery.

Owing to the fact that the margin of the chondroplastic flap and the skin of the alar rim are already adhered in about 10 to 12

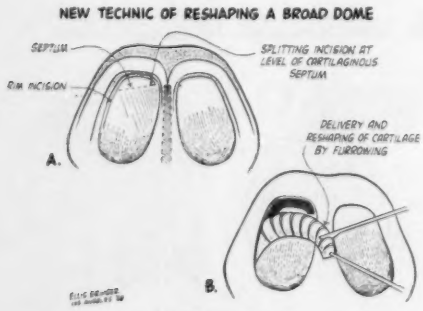


Figure 14

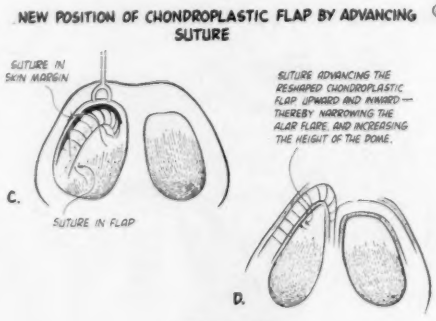
NEW POSITION OF CHONDROPLASTIC FLAP BY ADVANCING SUTURE
SUTURE IN SKIN MARGIN
SUTURE ADVANCING THE RESHAPED CHONDROPLASTIC FLAP UPWARD AND INWARD — THEREBY NARROWING THE ALAR FLARE AND INCREASING THE HEIGHT OF THE DOME.
SUTURE IN FLAP
C.
D.

Figure 15

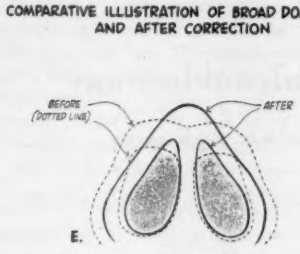


Figure 16

hours, the compression sling about the columella and lower lateral cartilages is removed 24 hours after surgery. Prolonged pressure in that area is objectionable, as it may be injurious to the skin.

## Summary

With this new approach to lower vault surgery, the following are accomplished:

1. Owing to the fact that the delivered chondroplastic flap contains all of the lateral crus, the dome, and part of the mesial crus, surgery of the arch is greatly simplified, complete control being maintained at all times.

2. There is no interruption of the cartilage at the dome; thus any possible deformity at the most prominent part of the nose is precluded. The scar formed by the healed incision will be posterior to the columella—in the mesial crus.

3. The columella is fixed to the septum as one piece extending from its base at the level of the nasal spine to its apex, which is the remaining amputated portion of the mesial crus. This is a fixed part and cannot override the nasal dorsum.

4. Since the line of the nasal dorsum has been extended to the height of the stump of the mesial crus, we can overlay the chondroplastic flap with its dome over the dorsum of the septum, thus obtaining fixation with the desired height. This I call the *sliding flap technique* (Fig. 17).

It is the intent of this paper to introduce a new concept and approach to nasal surgery of the cartilaginous vault. However, along the way I have taken the liberty to touch lightly on some of the problems other than the vault which are very important in the attainment of a successful result.

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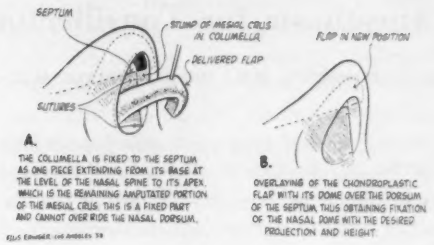
TECHNIC OF LOWER LATERAL SLIDING FLAP
SEPTUM
STUMP OF MESIAL CRUS IN COLUMELLA
DELIVERED FLAP
SUTURES
A.
THE COLUMELLA IS FIXED TO THE SEPTUM AS ONE PIECE EXTENDING FROM ITS BASE AT THE LEVEL OF THE NASAL SPINE TO ITS APEX, WHICH IS THE REMAINING AMPUTATED PORTION OF THE MESIAL CRUS. THIS IS A FIXED PART AND CANNOT OVER RIDE THE NASAL DORSUM.
FLAP IN NEW POSITION
B.
OVERLAYING OF THE CHONDROPLASTIC FLAP WITH ITS DOME OVER THE DORSUM OF THE SEPTUM, THUS OBTAINING FIXATION OF THE NASAL DOME WITH THE DESIRED PROJECTION AND HEIGHT.

Figure 17

# Anesthesia for Tonsillectomy and Adenoidectomy

W. E. PEMBLETON, M.D.; THOMAS WALKER, M.D., and JOHN A. GILL, M.D., Richmond, Va.

An axiom of safe anesthesia for surgery of the oropharynx is that an endotracheal tube should be present, and that in its absence fatalities occur since encroachment of the airway is inherent in the employment of any other method. However, as a rule the endotracheal technique is not employed for tonsillectomies and adenoidectomies for several reasons.

Chief among these reasons perhaps is the fear of complications; others include the belief that the technique entails greater time and difficulties, and objections from the surgeon on the ground that it interferes with the operative procedure. It cannot be said that other methods of anesthesia for tonsillectomies and adenoidectomies are so perfect that they do not warrant improvement, for everyone associated with this type of surgery is aware of fatalities that have occurred.

Bishop[1] cites 942 deaths accompanying tonsillectomies and adenoidectomies among 6,250 deaths associated with anesthesia over a nine-year period, according to statistics of the United States Bureau of Census. Of nine deaths associated with tonsillectomies and adenoidectomies which were reviewed by the Philadelphia Anesthesia Study Commission,[2] eight were preventable. Tonsillectomies and adenoidectomies are elective operations, and patients undergoing these procedures are presumed to be in satisfactory physical condition to withstand the surgery; therefore, it must be assumed that fatalities, when they occur, do so as a result of anesthetic or surgical mismanagement.

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Department of Anesthesiology (Drs. Pembleton and Walker) and Department of Otology, Rhinology and Laryngology (Dr. Gill), Medical College of Virginia Hospital.

Preoperative sedation for children is another matter on which there is no unanimity of opinion, and in cases of tonsillectomy and adenoidectomy frequently the simple expedient of omitting preoperative sedation entirely is employed. As with adult patients, there are advantages and disadvantages to employment of preoperative medication in children, and in this group satisfactory sedation is more difficult to achieve. There are, however, definite indications for its use.

From the psychological standpoint there is perhaps greater indication for preoperative sedation in children than in adults, as several studies have demonstrated emotional and behavior problems associated with and subsequent to the stress of anesthesia and operation in children.[3,4] Other studies have indicated that physiological aberrations which can be avoided with preoperative sedation have occurred in unpremedicated children.[5] That poor preoperative preparation may adversely affect the entire anesthetic procedure is a fact known to every anesthesiologist.

In the series presented here there were 6,492 cases in which endotracheal anesthesia was used. Sedation with thiopental (Pentothal) sodium was employed in almost all cases.

## Method

All except a few of the older children were given thiopental sodium rectally. Although the average dose was 15 mg. per pound, sometimes the amount was reduced in asthenic-appearing children. Occasionally the children did not go to sleep, and in such instances an additional dose was given but never in excess of a total of 20 mg. per pound.

Patients over 2 years of age were given 1/150 grain (0.40 mg.) of atropine and those 2 years of age and under were given 1/200 grain (0.30 mg.).

Anesthesia was induced by the open-drop technique, using vinyl ether (Vinethene) and ether,

and a Portex endotracheal tube was inserted when the depth of anesthesia was adequate to insure an atraumatic procedure. The nonrebreathing technique with a Stephen-Slater valve with oxygen, nitrous oxide, and ether was then employed. Depth of anesthesia could be varied in accordance with the surgeon's requirements, but special effort was made to have the patients as lightly anesthetized as possible at termination of the procedure.

## Results

Use of thiopental sodium rectally did not produce undue respiratory or other depression, and no complications resulted. The children slept for varying lengths of time postoperatively but could be roused if desired.

No complications followed employment of an endotracheal tube, and there were no instances of respiratory difficulty or other indications of laryngeal edema. The time required for institution of this type of anesthesia was not longer than that required for any other type; in fact, the time averaged about six minutes from the beginning of the open-drop induction to insertion of the endotracheal tube. The immediate postoperative course of these patients was unusually good. A large percentage of them vomited only in the operating room in response to stimulation, immediately after operation.

## Comment

The absence of complications in this series, as well as in some reported by other authors,[6,7] suggests critical reevaluation of anesthetic procedures for tonsillectomies and adenoidectomies.

The psychic response of children should probably be given more attention than it has been accorded by most anesthesiologists, as has already been suggested by other workers.[8,9] Use of thiopental sodium rectally is a very satisfactory means of providing sedation. Although a few of the children were not completely asleep on arrival in the operating room, they were placid and unconcerned, and anesthesia was easily induced.

The outstanding advantage of thiopental anesthesia rectally for children undergoing tonsillectomy is the favorable psychological effect. From the time the child enters the hospital until he leaves a day or so later, he is subjected to a series of new and sometimes frightening experiences, the most important of which may be the child's separation from his parent. The journey to the operating room may be a crisis for the parent as well as the child and may result in tears for both.

Another emotional crisis may occur when the child is transported from the stretcher to the operating table and he feels hands and restrainers attempting to immobilize him. Unless skilful and soothing tact is exercised by the anesthesiologist, these incidents may implant terror in a fully conscious child who is poorly adjusted emotionally. Some anesthesiologists are expert at handling recalcitrant children, but in the confines of a busy operating room schedule sometimes there is not time for much tact, and an ether mask may be placed over the face of a vociferous child without preliminary rationalization.

We who are accustomed to operating room procedures may forget that, for a child who is experiencing these preparations for the first time, the situation may provide a real emotional shock. Some children perform beautifully, but no one can predict precisely how a child will react, and therefore we feel that it is advisable to eliminate this uncertainty by administering thiopental rectally to the child while he is still in his room with his parent. Thus the child is spared not only conscious separation from his parent but also an awareness of operating room procedures.

The argument against use of thiopental is that the procedure requires more steps, and any procedure with additional steps is more complicated and, therefore, more subject to failure. Administration of thiopental demands subsequent use of the endotracheal tube, which alone can be a hazardous venture unless it is in the hands of an expert worker. However, this objection is virtually nullified when the anesthesiol-

ogist meets the two following requirements: (1) that he be skilful, and (2) that he be accustomed to administering anesthesia for tonsillectomy frequently.

A disadvantage of the preoperative use of thiopental rectally in children is the necessity for constant supervision from the time of administration of the drug. In addition, the medication sometimes acts as an enema. Another objection which has been advanced by some physicians is that patients are drowsy for some time postoperatively, although this effect does not seem to be of any significance. In our series no difficulties were encountered during this period or subsequently.

Another possible difficulty which has been feared with the preoperative use of thiopental rectally in children is that of respiratory depression. However, studies of blood oxygen saturation of children given thiopental rectally have demonstrated no abnormalities.[10] We did not observe evidence of respiratory depression in any patient in our series.

In our study we did not discover any valid reason for not using the endotracheal technique for this type of operation when the technique is employed by capable personnel. On the other hand, there are many objections to the more usual insufflation method.

In practically every instance where the insufflation technique is used, there is a significant degree of impairment of respiratory exchange due to laryngeal spasm, the presence of blood and mucus in the air passages, or obstruction to the airway by the tongue. It is not possible to state the percentage of reduction of tidal air which ensues under these conditions. However, that faulty oxygenation, impaired carbon dioxide elimination, and altered intrapulmonary pressure occur is certain.

Oximetric studies have demonstrated that when laryngeal spasm occurs, there is a sudden and precipitous fall of oxygen saturation to alarmingly low levels, with a slow return to normal.[11] In a summary of factors causing operating room deaths, Dillon [12] cites two fatalities ascribed to laryngospasm and subsequent anoxia. The Philadelphia Anesthesia Study Commission reviewed 307 deaths associated with anesthesia and found that 17 had resulted from laryngospasm during operation.

Various persons have reported that, on bronchoscopy, blood is present in the trachea of patients who have undergone tonsillectomy and adenoidectomy with insufflation anesthesia.[13] In children even a minor degree of obstruction, with its increased resistance, rapidly leads to marked fatigue and impaired respiratory function.

There is considerable blood loss during tonsillectomy and adenoidectomy, and because of their small initial blood volume, this loss assumes greater significance in children. When the effects of faulty oxygenation are added, the possibility of shock is increased. Undoubtedly these factors have been responsible for many of the catastrophies that have occurred following tonsillectomy and adenoidectomy in children.

There is evidence that abnormal oxygen and carbon dioxide tensions increase the likelihood of arrhythmia and other disturbances of cardiovascular function.[14-16] An outstanding characteristic of our patients was their healthy pink color throughout the entire procedure, a situation which is practically observed during insufflation anesthesia.

The reason for reduction of postoperative nausea and vomiting is difficult to determine accurately, but it was obvious in this series of patients that it was markedly reduced over that in other patients given insufflation anesthesia at the same time. Parents of children undergoing tonsillectomy and adenoidectomy substantiate this opinion. In many instances parents who had had previous experience in observing another child or children regain consciousness in the wake of insufflation anesthesia would remark how pleasantly surprised they were with the tranquillity of their child's recovery follow-

ing the endotracheal method with thiopental administered rectally preoperatively.

This tranquil recovery is due partly to the fact that administration of thiopental rectally results in the need for less inhalation anesthesia and also in large part to the absence of anoxia during the procedure. Although complications have been reported following use of endotracheal anesthesia in children,[17] such results have not been reported following tonsillectomy and adenoidectomy.

Objection to use of the endotracheal tube arises because its presence in the operating field tends to crowd the surgeon away from this working area. This impediment, when combined with the difficulty of working in a deep cavity, is not easily overcome by the uninitiated. However, experience can surmount this technical difficulty so that use of the endotracheal tube will not interfere with adequate exposure of the work area. In fact, instead of interfering with the surgical procedure, it was the opinion of all the surgeons who became accustomed to this type of anesthesia that it provided better operating conditions for them and that exposure was facilitated.

## Summary

In 6,492 cases of tonsillectomy and adenoidectomy use of endotracheal anesthesia with preoperative thiopental (Pentothal) sodium sedation administered rectally is reported. There were no complications.

Acknowledgment is made to Peter N. Pastore, M.D., G. Douglas Hayden, M.D., and M. P. Smith, M.D., for their contribution of clinical material.

Medical College of Virginia, Hospital Division.

## REFERENCES

1. Bishop, H. F.: Operating Room Deaths, Anesthesiology 7:651-662 (Nov.) 1946.

2. Ruth, H. S.; Haugen, F. P., and Grove, D. D.: Anesthesia Study Commission: Findings of 11 Years' Activity, J. A. M. A. 135:881-884 (Dec. 6) 1947.

3. Jackson, K.; Winkley, R.; Faust, O. A., and Cermack, E. G.: Problems of Emotional Trauma in Hospital Treatment of Children, J. A. M. A. 149:1536-1538 (Aug. 23) 1952.

4. Levy, D. M.: Psychic Trauma of Operations in Children and Note on Combat Neurosis, Am. J. Dis. Child. 69:7-25 (Jan.) 1945.

5. Jackson, K.: Tachycardia in Children During Anesthesia, Anesthesiology 9:573-584 (Nov.) 1948.

6. Pender, J. W., and Hallberg, O. E.: Endotracheal Anesthesia for Tonsillectomy and Adenoidectomy in Children, J. A. M. A. 153:1073-1074 (Nov. 21) 1953.

7. McCarthy, K. C.: Endotracheal Nitrous Oxide Anesthesia for Tonsillectomy: Report of 1,550 Cases, Anesthesiology 1:216-222 (Sept.) 1940.

8. Coleman, L. L.: The Psychologic Implications of Tonsillectomy, New York J. Med. 50:1225-1228 (May) 1950.

9. Reducing Emotional Trauma in Hospitalized Children, Departments of Pediatrics and Anesthesiology, Albany Medical College, Albany Research Project, Albany, N. Y.

10. Marbury, B. E.: Study of Blood-Oxygen Saturation in Children under Rectal Pentothal Anesthesia, Anesthesiology 11:589-591 (Sept.) 1950.

11. Stephen, C. R.: Technics in Pediatric Anesthesia—Non-Rebreathing Method, Anesthesiology 13:77-85 (Jan.) 1952.

12. Dillon, J. B.: Consideration of Some Factors Causing Death in Operating Room, California Med. 71:353-355 (Nov.) 1949.

13. Steele, C. H., and Anderson, J. R.: Tracheobronchial Aspiration Following Tonsillectomy with General Anesthesia, Arch. Otolaryng. 51:699-706 (May) 1950.

14. Resnik, W. H.: Observations of Effect of Anoxemia on Heart: I. Auriculo-Ventricular Conduction, J. Clin. Invest. 2:93-115 (Oct.) 1925.

15. Altschule, M. D., and Sulzbach, W. M.: Tolerance of Human Heart to Acidosis: Reversible Changes in RS-T Interval During Severe Acidosis Caused by Administration of Carbon Dioxide, Am. Heart J. 33:458-463 (April) 1947.

16. Sloan, H. E.: Vagus Nerve in Cardiac Arrest: Effect of Hypercapnia, Hypoxia and Asphyxia on Reflex Inhibition of Heart, Surg. Gynec. & Obst. 91:257-264 (Sept.) 1950.

17. Crispell, L. S., and Hampton, L. J.: Laryngeal Edema Complicating Endotracheal Anesthesia in Children: Case Reports, Connecticut M. J. 14: 98-99 (Feb.) 1950.

# Ruptured Intracranial Carotid Artery Aneurysm with Fatal Epistaxis

DANIEL M. SEFTEL, M.D.; HARRY KOLSON, D.D.S., M.D., and BENJAMIN S. GORDON, M.D., New York

Intracranial aneurysms are primarily a neurosurgical problem. The patient with an intracranial aneurysm may be seen initially, however, by the ophthalmologist or the otolaryngologist. It is the purpose of this paper to review the subject of traumatic internal carotid artery aneurysm, show how epistaxis may be a conspicuous part of the clinical features, and present an illustrative case.

## Anatomy

In order to comprehend fully the symptoms produced by the intracranial aneurysm, a brief review of the intracranial course of the internal carotid artery is indicated.

As the internal carotid artery ascends into the carotid canal, it lies anteroinferior to the tympanum and cochlea, posteromedial to the Eustachian tube and the canal for the tensor tympani muscle (Fig. 1). Only a very thin lamella of bone separates the artery in its canal from the Eustachian tube and tympanum (Fig. 2) and this lamella frequently is found to be perforated. As the artery emerges from the carotid canal, it is found to be adjacent, just below, and medial to the trigeminal ganglion.

The artery runs forward, piercing the external layer of the dura mater in the lateral wall of the cavernous sinus. The oculomotor, trochlear, and abducens nerves and the ophthalmic division of the trigeminal nerve are found lateral to the artery within the sinus (Fig. 3).

As it approaches the lesser wing of the sphenoid bone, it turns superior to the medial side of the anterior clinoid process, pierces the inner layer of the dura mater and the arachnoid, and runs backward, fre-

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From the Otolaryngology Section of the Surgical Service and the Laboratory Service, Veterans Administration Hospital and Albert Einstein College of Medicine.

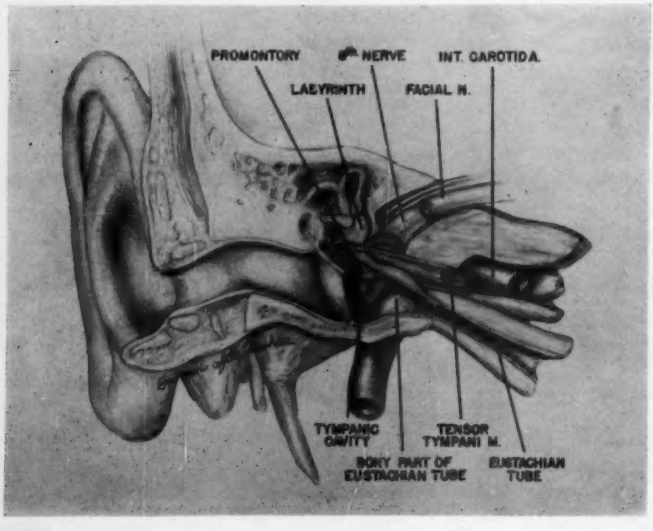


Fig. 1.—Oblique sagittal section through temporal bone.

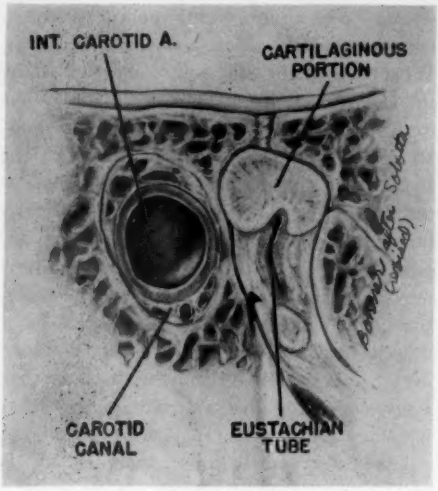


Fig. 2.—Frontal section.

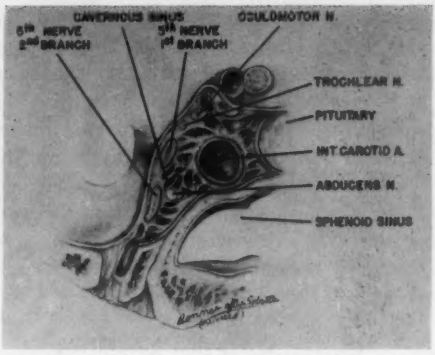


Fig. 3.—Frontal section of cavernous and sphenoid sinus.

quently forming a groove in the lateral wall of the sphenoid sinus (Figs. 3 and 4). It also comes in close relation with the inferior surface of the optic nerve just behind the optic foramen in this area. In its posterior course it comes between the optic and oculomotor nerves and finally turns upward at some distance from the optic chiasma to divide into the anterior and middle cerebral arteries. Here again, it is important to note the intimate relationship between the carotid artery and sphenoid sinus. Van Alyea [1] emphasizes that "irregularities in the wall of some sinuses are so numerous as to display an intimate relationship between the sinus and all of the nerves and blood vessels in the sphenoid area. The internal carotid artery leads the others not only in frequency but also in degree of projection into the sinus. A carotid elevation was present in 65 of the 100 specimens. In 53, the condition was pronounced. In 14 of the 53, the vessel could be traced throughout its entire serpentine course along the sinus wall." Sjöqvist [2] reported a case in which angiography was performed after iodized oil

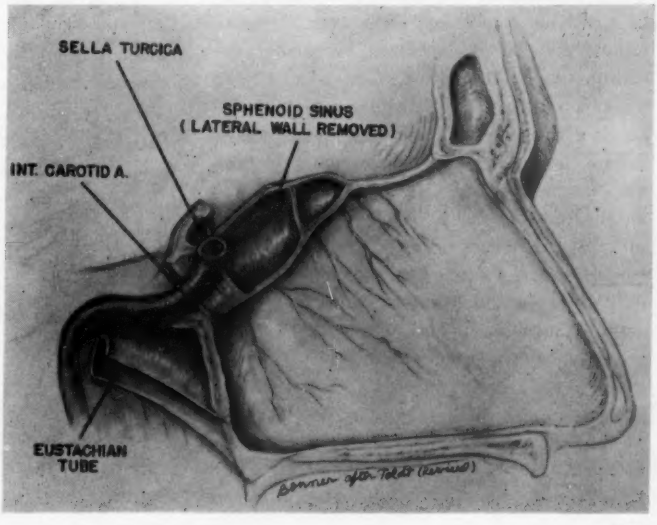


Fig. 4.—Sagittal section of sphenoid sinus.

(Lipiodal) had been introduced into the sphenoidal sinus. Only a thin layer of bone was seen to intervene between the aneurysm and the sinus. A case of aneurysm in the sphenoidal sinus was described by Hirsch.[3] A tumor was identified by x-ray within the sphenoidal sinus of a 53-year-old woman; there was no history of trauma to the head or epistaxis. This was incised via a transnasal approach, resulting in a fatal hemorrhage.

### Clinical Signs and Symptoms

With increased awareness that an aneurysm can be produced from an injury to the head, many minor or insignificant clinical symptoms demand the attention of the physician. The fully ruptured aneurysm announces itself with catastrophic suddenness. The patient abruptly complains of a splitting headache, followed by vomiting, syncope, meningismus, confusion, coma, and death.

The more discrete initial and subsequent clinical symptoms of the traumatic aneurysms of the internal carotid artery usually depend on its localization.

According to Jaeger,[4] aneurysm in the carotid canal causes symptoms only when the lesion is of large size. Sharp head pains and headache about the forehead and eyeball are common. This suggests that paralysis of the fourth or sixth cranial nerve with a possible concomitant Horner's syndrome may be the result of an aneurysm in the carotid canal. If the aneurysm develops anteriorly near or at the foramen lacerum, it lies close to the Gasserian ganglion and its branches. Consequently, corneal hypoalgesia, anesthesia, or hyperesthesia of the infraorbital nerves, or even complete paralysis of the trigeminal nerve can occur. Pain may be projected into the orbit, inner canthus, forehead, and along the side of the nose. Bonnet[5] mentioned the point that when part of the trigeminal symptomatology is associated with paralysis of one or more of the eye muscles, aneurysm of the carotid artery at or near the foramen lacerum is a good possibility. When the association is with a seventh or eighth nerve paralysis, one must think of an acoustic neurinoma. When the aneurysm occurs more distally, involvement of the oculomotor nerve is almost a constant feature. This is demonstrated by complete or partial ptosis of the upper lid so as to obscure vision; the eye turns outward; the pupil is dilated and does not react to light, convergence, or consensually. Jaeger[4] stated that this paralysis may be periodic, usually lasting many weeks, then leaving for a period of weeks or months to recur. The fourth or sixth cranial nerves can be involved in this area as well. Unilateral exophthalmos may occur, along with cephalic bruit and possible pulsations. As the aneurysm is found more superiorly and anteriorly, pressure on the optic nerve or the optic chiasm can result in sudden or gradual unilateral visual failure and exophthalmos.

Meadows[6] emphasized the principal clinical symptoms in relation to the direction of expansion of an aneurysm in the cavernous sinus. He stated that "with gradual enlargement, there is severe unilateral trigeminal pain, followed by involvement of one or more of the third, fourth and sixth cranial nerves. The pain may be limited to the distribution of the first division of the fifth nerve and a corresponding cutaneous sensory loss is common with impairment or loss of the corneal reflex. Posterior expansion of the aneurysm involves the second or third division of the fifth nerve. Anterior expansion leads to pressure on the optic nerve with gradual unilateral visual failure and exophthalmos. Medial expansion can result in pressure on the optic chiasm or nerve, with bilateral hemianopsia or unilateral visual failure with perhaps severe pain."

In an analysis of 31 cases of intracranial carotid aneurysm, Jaeger[4] found that the combined symptoms of oculomotor paralysis or paresis associated with frontal or orbital head pains are sufficient to permit a presumptive diagnosis.

*Summary of Cases of Epistaxis Due to Intracranial Aneurysm*

| Authors | Patient's Age | Sex | Nature of Trauma | Epistaxis | Operative Procedure | Site of Aneurysm | Result |
|---|---|---|---|---|---|---|---|
| Birley & Trotter[8] | 23 | M | Motor accident | Moderate to severe | Ligation of internal and external carotid artery | Assumed to be sphenoid sinus | Recovered |
| Hamby[10] | Unknown | M | Unknown | Severe | None | Sphenoid sinus | Died |
| Davis[11] | Unknown | M | Motorcycle accident | Severe | Ligation of common carotid | Assumed to be sphenoid sinus | Recovered |
| Rousseau and Spillman[12] | Unknown | F | Fall | Severe | None | Sphenoid sinus | Died |
| Rousseau and Spillman[12] | Unknown | M | Fall | Severe | Ligation of common carotid | Assumed to be in the carotid canal rupturing into Eustachian tube | Recovered |
| Schorstein[14] | 24 | M | Removal of nasal polypi | Severe | Ligation of internal carotid | Assumed to be sphenoid sinus | Recovered |
| Griffiths[15] | 23 | M | Bullet wound | Severe | Ligation of both common carotids | Assumed to be sphenoid sinus | Unknown |
| Delens[16] | 21 | M | Penetrating injury through eye | Severe | None | Sphenoid sinus (autopsy) | Died |
| Bonnet[17] | 31 | F | Automobile accident | Moderate to severe | External carotid ligation followed by internal carotid ligation | Sphenoidal sinus | Died |
| Seftel | 29 | M | Automobile accident | Moderate | None | Sphenoid sinus | Died |

Brihaye et al.[7] have established the following criteria for trauma as the cause of an intracranial aneurysm:

1. Trauma must affect the head.
2. Symptoms of concussion must exist after the trauma.
3. Between trauma and demonstration of the aneurysm, bridge symptoms like headache, epileptic attacks, fatigue, paralysis, and others must exist. (We should like to add the possibility of epistaxis as well.)
4. The cardiovascular system must be normal.
5. The presence of multiple aneurysms excludes a traumatic etiology.
6. The rupture of the aneurysm must be separated by a latent period of at least several days.
7. Rupture must occur without a new trauma.
8. The presence of hemosiderin pigment at the level of the aneurysm at autopsy suggests previous trauma.

With these criteria in mind, 10 cases were found, including our own, in which epistaxis was the result of a traumatic aneurysm (Table).

## Report of Case

A 29-year-old white man was rendered unconscious in an automobile accident on Jan. 22, 1957, for a short undetermined period of time.

Physical examination, soon after the accident, revealed a laceration across the left eyebrow extending to the periosteum of the skull. The pupil on the right reacted to light and accommodation; the pupil on the left was dilated and fixed, the eye pointing upward and laterally. There was bleeding from the nasal passages. The patient apparently had had an active epistaxis before entering the emergency room, but there was no leakage of cerebrospinal fluid. Examination revealed only mental confusion. Deep tendon reflexes were equal and physiologic. Roentgenograms showed nondisplaced fractures of the fourth, fifth, and sixth ribs on the right in the anterior axillary line. There were multiple fine-branching fractures of the left frontal bone extending into the roof of the left orbit and ending in the superoposterior portion of the left orbital cavity, the most superior of these fracture lines extending into the superior portion of the left frontal sinus. The right knee revealed cortical infractions and tiny chip fractures in the medial tibial plateau.

One month after the accident the patient was transferred to this hospital. He was weak, complained of a poor appetite, frontal headaches, and paresthesia of the left frontal region. He had been having minor nosebleeds since the accident almost daily. The patient was known to have had grand mal epilepsy since the age of 11 years, but had

not manifested any signs of epilepsy for several years prior to admission.

Physical examination revealed a blood pressure of 120/80 mm. Hg. The patient was pale, oriented, and cooperative. Fresh blood clots were present in the left posterior nasopharynx. The left eye was totally ptotic. A scar extended from the medial aspect of the left brow, to the left lateral canthus. The left eye showed normal fourth and sixth cranial nerve function. It could not be elevated or depressed to the left nor could it be brought past the midline nasally. There was no nystagmus. The right pupil reacted to light and accommodation but not consensually. The left pupil was larger than the right. The results of visual acuity tests without correction were: O. D., 20/15; O. S., no light perception, not improvable. The left fundus showed a disc which was faintly paler than the right disc, but which was not definitely atrophic. Vessels in the left fundus were slightly less prominent than those on the right. The left macula was red with a surrounding paler area, which in turn was surrounded by an area of scleral sclerosis extending from the intranasal quadrant.

An electroencephalogram showed an abnormal record with a slow wave defect in the left hemisphere. This may have been due to recent trauma, since the general pattern showed improvement compared to a tracing taken eleven years previously.

*Hospital Course.*—Nerve regeneration became apparent with slight elevation of the left eyelid and increase in ability to bring the eye medially. It was felt that no ophthalmic surgery was indicated until the patient had been observed for approximately one year. The symptoms of headache and anorexia rapidly improved. Vital signs remained stable during the hospital stay. Some blood was seen in the nasopharynx and oropharynx daily, but there was no evidence of any active bleeding point. No further treatment was necessary. The patient was discharged on March 8, 1957. Approximately two months after this discharge, he returned to the Clinic with a complaint of daily recurrent epistaxis from the left naris, increasing in frequency for approximately two weeks. He was readmitted to the hospital on June 12, 1957.

On admission the patient stated that three days ago he had had a massive nasal hemorrhage which necessitated admission to another hospital. His blood pressure was then 75/50 mm. Hg. Five hundred cubic centimeters of whole blood and 500 cubic centimeters of dextran (Plavolex) were administrated immediately, and the blood pressure rose to 100/60 mm. Hg. He did not bleed while in that hospital. The red blood count was 3,500,000 per cubic millimeter; hemoglobin 9.3 gm., white blood count 11,400 per cubic millimeter.

The physical examination revealed blood pressure of 100/66 mm. Hg. The left pupil was dilated and fixed. There was no vision in the left eye, and there was ptosis of the left upper lid. The nose revealed a deviated septum to the left with a sharp vomerian ridge. No bleeding point would be visualized. Dried blood was noted in both choanae.

Soft tissue studies of the neck and Waters projection of the paranasal sinuses revealed no evidence of encroachment on the air column and nasopharynx. No abnormalities were visualized in the neck. The paranasal sinuses were normal. Hematocrit value on June 18, 1957, was 31%; hemoglobin 11.8 gm. per 100 cc. of blood.

He continued to have mild epistaxis and occasional throbbing headaches on the left side, relieved on several occasions by meperidine (Demerol) intramuscularly. Because of the patient's poor general condition and anemia, the contemplated submucous resection was deferred. He bled almost daily for a brief period of time from the left nostril, requiring occasional packing with petrolatum gauze. A repeat electroencephalogram revealed a slow wave defect on the left side about the same as that seen in tracings done on March 1, 1957.

During his hospital stay, he was out of bed, ambulatory, friendly and cooperative. On the eve-

Fig. 5.—Region of tuberculum sellae (dorsal view). *A*, internal carotid artery. *B*, communication through to sphenoid sinus. *C*, aneurysmal erosion of sphenoid sinus, tuberculum sellae, and clinoid processes. *D*, lesser wing of sphenoid, left. *E*, lesser wing of sphenoid, right. *F*, dorsum sellae.

ning of June 20, 1957, he again complained of throbbing headache and epistaxis from the nose. He then began to bleed so profusely from his mouth and nose that suction could not evacuate the blood. The patient became exsanguinated.

*Postmortem Examination.*—There were found an obliterative fibrous pleuritis on the right, microscopic foci of fibrocaseous pulmonary tuberculosis, and pulmonary hemosiderosis.

The most significant changes were found in the cranial cavity. The left half of the anterior wall of the sella turcica and the greater portion of the roof of the sphenoid sinus were absent. A linear fracture was noted in the anterior fossa on the left, at the junction of the medial and lateral halves, extending anteriorly from the posterior margin for a distance of 1.25 cm. A hemorrhage was present in the wall of the sphenoid sinus.

The brain showed multiple areas of hemosiderin deposition superficially in the meninges of the left frontal lobe and left temporal lobe, with contusions in the underlying cerebrum.

There was a large aneurysm, roughly pyriform in shape, measuring 2.5 cm. in its greatest dimension from side to side, which arose from the left internal carotid artery. The aneurysm had extended medially and superiorly to lie medial and dorsal to the left optic nerve. The tuberculum

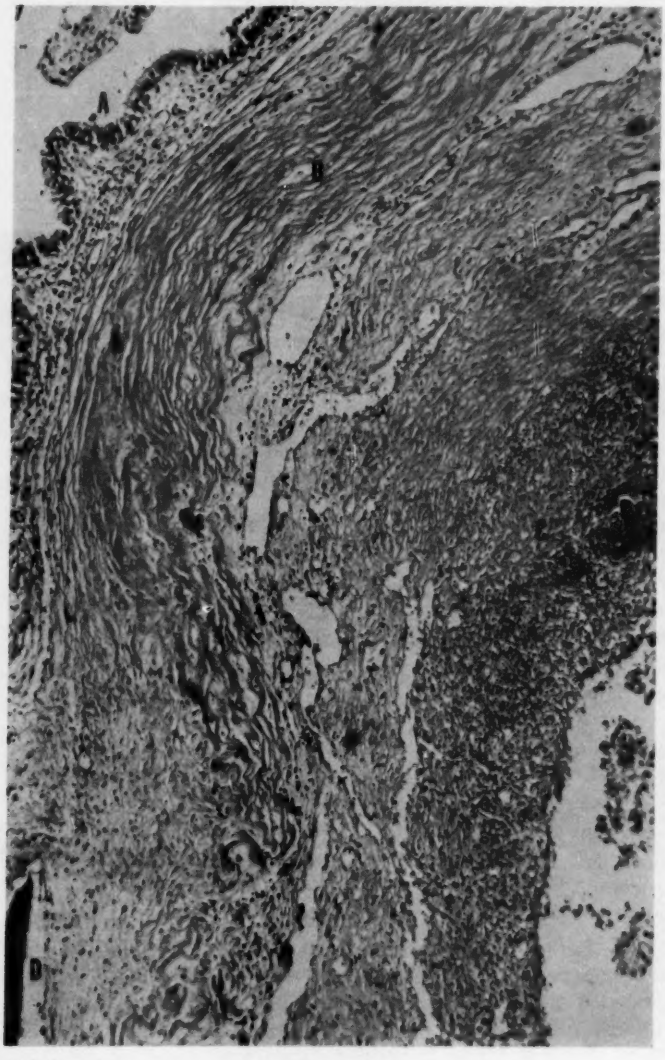


Fig. 6.—Photomicrograph of internal carotid artery and aneurysm. *A*, mucous membrane of sphenoid sinus. *B*, wall of aneurysm. *C*, thrombus. *D*, bone. Reduced slightly from mag. × 100.

sellae and clinoid processes were eroded. The aneurysm had ruptured anteriorly and on its right lateral and ventral surfaces, where a large defect measuring 1 cm. in diameter was present. This defect lay in relation to the sphenoid sinus cavity (Fig. 5).

Microscopic examination of the tissue at the site of the ruptured aneurysm disclosed a portion of the carotid artery in which the aneurysmal wall is thinned. The intima is slightly thickened by organized thrombus to which is adherent a large mass of thrombus material of varying age. The media, as well as the internal elastic lamina, has been destroyed and replaced by laminated layers of collagenous connective tissue. The latter lies in close apposition to the submucosal connective tissue of the sphenoid sinus, with no interposition of bone (Fig. 6).

## Comment

Few traumatic aneurysms of the internal carotid artery have been reported in the literature, and rarely has epistaxis been noted as a conspicuous part of the clinical picture. Ten cases of epistaxis due to an intracranial aneurysm have been reported. Seven of these gave some history of previous trauma to the head. Considering the anatomy and mechanism of injury described below, epistaxis secondary to intracranial aneurysm must occur relatively frequently, and either has not been reported or has not been recognized. It is interesting to note that in 1928, in reporting a case of epistaxis due to a ruptured intracranial aneurysm, Birley [8] mentioned the relationship of the sphenoidal sinus to the middle fossa and stated: "It is therefore all the more curious that no example of epistaxis occurring as a late result of intracranial aneurysm, either traumatic or nontraumatic, appears to have been recorded."

DeVeer and Browder [9] maintained that in addition to rupture with immediate hemorrhage, or vascular occlusion by thrombosis, a third possible vascular lesion can occur; namely, aneurysmal dilatation of the injured vessel wall with rupture occurring days, weeks, or even months after injury. Hamby [10] stated that there is little doubt that trauma can cause aneurysms of the internal carotid artery, or that the artery itself can rupture into the cavernous sinus, producing an arteriovenous communication. However, he added that aneurysms of the intracranial vessels that are caused by trauma are extremely rare. In a more recent paper, Brihaye, Mage, and Verriest [7] mentioned that the hypothesis of torsion of the vessel followed by tearing of its wall, as a pathogenic mechanism of traumatic aneurysm, is strengthened by studies of the cerebral alterations in electrocuted criminals. Nonspecific parenchymatous alterations similar to those seen after head trauma were encountered. Tears of the vascular walls were frequent, generally of the large basal vessels, usually involving the elastic layer, but also the muscular layer and even the adventitia. This was attributed to the fact that the electric current travels along the vessels and provokes their contraction, torsion, and separation from the surrounding pia.

There are a number of factors that can probably influence occurrences of intermittent bleeding, such as fluctuation of the systolic and diastolic pressure, the oxygen and carbon dioxide content of the blood and surrounding tissues, hormonal influences as governed by the patient's emotions, atmospheric conditions, and perhaps certain idiopathic conditions that have not been elucidated. However, Richardson and Hyland [11] found that the activity of the patient at the time of hemorrhage was of little importance in determining its onset or severity. The patients were at rest in bed, standing, or walking in 78% of the cases; undue muscular exertion appeared to precipitate the onset in only about 18%. The authors concluded that the rupture of an aneurysmal sac is usually a gradual process of stretching and hemorrhagic dissection, and that in only a few cases is a tear completed by sudden increase in blood pressure due to violent muscular effort. In Hamby's [10] series most of the patients were at their usual work, driving a car, walking, sitting, standing, and even in several instances, asleep. Hamby also felt that the patients' activity at the time of onset of bleeding was unimportant.

Epistaxis may occur as a result of the erosion and rupture of an aneurysm into the sphenoid sinus, the Eustachian tube, or the cribriform plate.

It is well known that aneurysms or abnormal blood vessels can gradually erode through solid bone. This is readily seen where an aortic aneurysm has eroded the bodies of vertebrae. In coarctation of the aorta notching or scalloping under the lower edges of the ribs results from the increased size, tortuosity, and elongation of the intercostal arteries.

Aneurysms, traumatic or otherwise, tend to occur in the cavernous portion or superior extracavernous portion of the internal carotid artery. Epistaxis by erosion into the sphenoid sinus is the one most frequently encountered. Of incidental interest is a statement by Davis [12] that the sphenoid air sinus is opened in about 70% of fractures of the middle fossa of the skull. Figures 3 and 4 demonstrate that the artery lies in close approximation to the lateral wall of the sphenoid sinus and may even groove the wall. An aneurysm in this location or one that is extended to this area from several millimeters distant can easily erode the thin lateral wall of the sinus. In many skulls which we personally examined, the bony wall was less than 2 mm. in thickness. The process of bleeding and clotting within the sinus can readily produce intermittent epistaxis via the sphenoid ostia.

The second possible site of nasal bleeding is the traumatic aneurysm of the carotid artery within the carotid canal. Here again, there is only a thin lamella of bone between the carotid canal and the Eustachian tube (Fig. 2). There may be only a thin, bony cribriform type of barrier between them. A rupture here will produce posterior pharyngeal bleeding and anterior epistaxis. Rousseau and Spillman [13] reported such a case where nasopharyngoscopy revealed some blood clots around and in the Eustachian tube orifice.

The third possibility, which has never been reported and is the least likely to occur, but is quite feasible anatomically, is bleeding through the cribriform plate. A lesion of one of the anterior cerebral vessels or its branches with an associated tear in the dura will produce epistaxis via the cribriform plate. A fracture line through the lesser wing of the sphenoid, in proximity to an aneurysm of the cavernous or extracavernous portion of the internal carotid artery, extending into the orbit along the ophthalmic artery, can produce epistaxis via the ethmoidal labyrinth or cribriform plate.

## Summary and Conclusions

Traumatic aneurysm of the internal carotid artery is primarily a neurosurgical problem. The initial clinical symptoms have been reviewed. Such aneurysms are not common, and even more unusual is epistaxis as a major symptom. Nine reported cases in the literature have been cited, of which one was confirmed by autopsy.

We have demonstrated how trauma to the head can produce an intracranial aneurysm, which in turn can lead to epistaxis. The epistaxis can originate in three possible sites: the sphenoid sinus, the Eustachian tube, or the cribriform plate. The otolaryngologist may be the first to examine such a patient. It is important to recognize that epistaxis may be the clue to the diagnosis of ruptured intracranial aneurysm.

130 W. Kingsbridge Rd., Bronx 68.

## REFERENCES

1. Van Alyea, O. E.: Nasal Sinuses, Ed. 2, Baltimore, Williams & Wilkins Company, 1958, p. 162.

2. Sjöqvist, O.: Über intrakranielle Aneurysmen der Arteria carotis und deren Beziehung zur ophthalmoplegischen Migräne, Nervenarzt 9:233-241, 1936.

3. Hirsch, O.: Pathology of the Sphenoidal Sinus, A. M. A. Arch. Otolaryng. 67:85-92 (Jan.) 1958.

4. Jaeger, R.: Aneurysm of the Intracranial Carotid Artery, J. A. M. A. 142:304-310, 1950.

5. Bonnet, P., and Bonnet, I.: Le syndrome du trou déchiré antérieur, symptomatique de l'anévrysme intra-caverneux de la carotid interne, Arch. Opht. 13:127-145, 1953.

6. Meadows, S. P.: Aneurysms of Internal Carotid Artery, Tr. Ophth. Soc. U. Kingdom 69:137-155, 1950.

7. Brihaye, J.; Mage, J., and Verriest, G.: Anévrysme traumatique de la carotide interne dans sa portion supraclinoidienne, Acta neurol. et phychiat. belg. 54:411-438, 1954.

8. Birley, J. L., and Trotter, W.: Traumatic Aneurysm of the Intracranial Portion of the Internal Carotid Artery, Brain 51:184-200, 1928.

9. DeVeer, J. A., and Browder, J.: Post-Traumatic Cerebral Thrombosis and Infarction, J. Neuropath. & Exper. Neurol. 11:24, 1942.

10. Hamby, W. B.: Intracranial Aneurysms, Springfield, Ill., Charles C Thomas, Publisher, 1952, p. 225.

11. Richardson, J. C., and Hyland, H. H.: Intracranial Aneurysms, Medicine 20:1-83, 1941.

12. Davis, E. D. D.: Severe Epistaxis, Difficult to Control, Brit. M. J. 1:721-723, 1939.

13. Rousseau, F., and Spillman, J.: Deux cas d'épistaxis incoercibles avec cécité homolatérale par lésion de la carotide interne intercránienne après chute sur la tête, Ann. oto-laryng. 68:461-465, 1951.

14. Schorstein, J.: Carotid Ligation in Saccular Intracranial Aneurysm, Brit. J. Surg. 28:50-70, 1940.

15. Griffiths, C. A.: Traumatic and Arterio-Venous Aneurysm, Brit. J. Surg. 3:302, 1915.

16. Delens, E.: De la communication de la carotide interne et du sinus caverneux, Thèse de Paris, 1870.

17. Bonnet, P.: Épistaxis mortelle par rupture traumatique de la carotide interne dans le sinus sphenoidal, Rev. oto-neuro-opth. 27:25, 1955.

# Malignancies of the Paranasal Sinuses

WILLIAM G. HEMENWAY, M.D., and JOHN R. LINDSAY, M.D., Chicago

Malignant disease of the paranasal sinuses is not common. During a period of approximately 25 years only 62 cases have been seen at the University of Chicago Clinics. The series includes only tumors considered to have originated within the sinuses. Tumors of the nose, palate, orbit, skin, or intracranial structures which have invaded the sinuses have been excluded.

## Characteristics

*Origin of Tumors.*—All lesions in this series originated in the antrum or ethmoids. There were no primary growths of the sphenoids or frontal sinuses, but these were, however, occasionally involved with tumor secondarily.

*Age.*—Two patients were in their 20's and two were in their 30's when first seen. Sixteen were in the 40 to 49 age groups; fourteen, in their 50's; twenty-one, in their 60's, and seven were 70 or over.

*Sex.*—Thirty-four patients were men, and twenty-eight were women.

*Side of Growth.*—In 40 cases the tumor was situated on the right side, while in 22 cases it was on the left.

*Histopathology.*—Histopathological diagnosis was made in all cases. There were 56 carcinomas (34 squamous-cell, 13 adenocarcinomas, and 9 unclassified carcinomas). Six tumors fell into the sarcoma group (one neurogenic sarcoma, one sarcoma of undetermined nature, three plasmacytomas, and one reticulum-cell sarcoma).

*Symptoms.*—(1) Unilateral nasal obstruction, 32 cases; (2) pain about the face, 30 cases; (3) swelling of the face, 20 cases; (4) ocular symptoms, 13 cases; (5) mouth symptoms, 11 cases; (6) bleeding from the nose, 6 cases; (7) anesthesia of the face, 6 cases; (8) purulent nasal discharge, 6 cases; (9) tinnitus and hearing loss, 1 case; (10) tenderness over the face, 1 case, and (11) trismus, 1 case.

Many combinations of these symptoms were seen in a given patient. There are no early symptoms of this disease. Obviously all these symptoms are due to invasion of the tumor into neighboring structures. Most cases in this group were far advanced when first seen.

*Signs Noted on First Examination.*—1. The presence of a mass in the nose, either granular or resembling polyps, was found in 44 cases. This was by far the commonest single finding. 2. A visible and palpable swelling of the face was seen in 24 cases. 3. A smooth mass or ulcerating lesion in the mouth was observed in 23 cases. 4. Abnormalities of the orbit were found in 15 cases. 5. Six patients had palpable metastatic cervical nodes. 6. Hypoesthesia over the distribution of the second division of the trigeminal nerve was recorded in four cases. 7. Pus in the nose (without a visible mass) was reported three times. 8. In two cases blood clots or bloody crusts were seen in the nose. 9. Secretory otitis occurred in two cases.

*Findings on Roentgenographic Films.*—All cases showed clouding of one or more sinuses. Sixty-six per cent of the cases showed definite destruction of the bony sinus walls on the first x-rays taken. This finding is practically diagnostic of sinus malignancy.

## Diagnosis

In earlier years the diagnosis of these lesions was difficult, and considerable delay was not unusual. During the past 10 or 15

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years the disease has been recognized more easily, and cases are somewhat less advanced when treated.

In 29 patients diagnosis was made by biopsy of a mass in the nose. Tissue removed at a Caldwell-Luc operation revealed a malignancy in 11 cases. Biopsy of a mouth lesion was positive in nine cases. Incision over a sublabial mass yielded the diagnosis in five cases. In two patients an intranasal ethmoidectomy was performed for diagnostic purposes. Sectioning tissue which came away with the roots of an extracted upper molar made the diagnosis in one patient.

In one patient the true nature of the condition was found by a frozen section of tissue removed at an external operation on the sinuses.

One case had a biopsy of a large mass which had ulcerated through the cheek. In three of the records the site of biopsy is not definitely stated.

In only 51 of the 62 cases is sufficient information as to treatment and follow-up available for them to be considered definitive. The remainder of this paper concerns these 51 patients. These include 45 carcinomas (27 squamous-cell carcinomas, 12 adenocarcinomas, and 6 unclassified carcinomas) and 6 sarcomas.

Results of therapy are generally disappointing, as is the usual experience in sinus malignancies.

Thirty-eight patients are dead, and two are dying of persistent disease (78% failures). Most of these died within a year of diagnosis, but a few lived two or three years, and one man survived five years. Eleven patients (22%) are alive and free of disease (one for over three years, one for over four years, and the remaining nine for over five years).

Results in the sarcoma group are the most promising. Of six cases, five are alive and well. The failure was a 21-year-old woman with a neurogenic sarcoma. She was treated by repeated operations, x-ray therapy, and radium and died four years after she was first seen. Initial surgery was too conservative because of an original pathological diagnosis of a benign lesion. The remaining five sarcomas were treated by x-ray therapy alone. They included three plasmacytomas, with the patients alive and well (3½, 4, and 6 years); one sarcoma of undetermined type (probably a reticulum-cell sarcoma), with the patient alive and well for 13 years, and 1 reticulum-cell sarcoma, with the patient alive and well for 8 years.

Of the carcinoma group, only 8 of 45 cases (17.7%) are free of disease. Only 4 of 27 patients with squamous-cell carcinomas (14.8%) are alive and well, while results are somewhat better in the adenocarcinoma group, with 3 cases out of 12 (25%) free of disease. Of the unclassified carcinomas none of six cases is alive and well. Most, if not all, of these are probably anaplastic squamous-cell carcinoma.

### Treatment of Carcinomas

Treatment of the carcinomas in this series was either radiation therapy, surgery, or a combination of the two. General present-day opinion in regard to treatment of paranasal sinus malignancy is that the best results are obtained when a combination of surgery and radiation therapy is employed. In the United States radical surgery, often followed by irradiation, is usually recommended. British and European authors advocate x-ray treatment first, often followed by surgery which seems to be less radical than that done in America. The surgery is done a few weeks after the course of therapy is completed.

We have arbitrarily divided our cases into those treated prior to 1948 and those treated from 1948 to the present.

In our series the treatment prior to about 1948 was predominantly radiation therapy, usually deep x-ray therapy, although radium was sometimes utilized. Surgery was mainly for diagnosis or the insertion of radium. Neurosurgical procedures were frequently done for the alleviation of pain, without much success. Before 1948, twenty cases were treated by irradiation alone; all of these were failures. Four cases were treated

by surgical procedures (which now would be considered conservative) followed by irradiation. All of these were also failures. The surgery had been done by both general surgery and otolaryngology. Thus there were no cures in these early cases.

About 1948, after a survey of results to that time, members of the otolaryngology department adopted the policy of radical surgical exenteration for carcinoma of the accessory sinuses.

The technique used has been that described by Schuknecht.[1] The entire subject of sinus carcinoma, as well as newer advances in technique, has recently been published in an excellent paper by Tabb.[2] A large defect is left in the palate, as this is the only satisfactory way that the patient can be followed up. Exenteration of the orbital contents is included in the procedure when indicated. Split-thickness skin grafts are used to line the cavity if electrocoagulation is not considered necessary. Ligation of the external carotid artery is often done. Three or four pints of blood are given during the procedure to maintain blood volume. The patients withstand surgery very well. There have been no deaths or serious surgical complications in any of our cases, although several were poor risks owing to cardiovascular disease. Usually a full course of x-ray is given in the postoperative period. Frequent postoperative examinations are made. Recurrences in the cavity are treated vigorously by electrocoagulation.

The patient is rehabilitated with the aid of a suitable prosthetic appliance. Cooperation with a good prosthodontist is essential in the management of such cases.[3]

All of our postoperative cases who are apparently cured are rehabilitated. They are able to work and lead reasonably normal lives.

Nineteen cases have been treated here since 1947. The results show a significant improvement over the previous group.

*X-Ray Therapy.*—There were eight cases in which x-ray therapy was the primary method of treatment. The method used at present is as follows:

At the present time the maxillary antrum is treated by two 8×8 cm. portals, one anteriorly and one laterally to include the palate and the inferior margin of the orbit. Attempt is made to avoid treating the lens on the uninvolved side. Wedge filters are placed in the treatment beam to make the dose uniform throughout the treated area. A tumor dose of 6,000 rads in six weeks is delivered through these two portals, with use of supervoltage, half-value layer 12.5 mm. of copper, focal skin distance 100 cm.

Results were as follows:

| | Cases, No. |
|---|---|
| (1) X-ray therapy alone | 3 |
| Dead | 3 |
| (2) X-ray therapy followed by radical surgery for recurrence | 5 |
| Dead | 3 |
| Alive with persistent tumor | 2 |

These eight cases were all failures. However, surgery was not performed immediately after the x-ray therapy in four of these patients. Several months elapsed before recurrence was obvious and the operation was done. Some of these might have been saved had the operation been done a few weeks after therapy was completed.

*Surgery.*—There were eleven cases in which surgery was the primary method of therapy. Results were as follows:

| | Cases, No. |
|---|---|
| (1) Surgery alone | 4 |
| Dead | 2 |
| Alive & well, (6 & 11 yr.) | 2 |
| (2) Radical resection of tumor followed by radiation therapy | 7 |
| Dead | 3 |
| Alive & well, (4, 5½, 6 & 9 yr.) | 4 |

Thus 55% of the cases treated by either surgery alone or surgery followed by x-ray are apparently cured.

The 19 cases treated here since 1948 were restudied in an effort to compare the two groups. None of them can be considered to be early cases, and many are far advanced. There was no clinical difference between the group treated primarily with x-ray and those treated surgically.

## Summary

Sixty-two cases of malignant diseases of the paranasal sinuses were reviewed.

Fifty-seven were carcinomas, the majority

of which were of the squamous-cell variety.

The adenocarcinomas had a better prognosis than the squamous-cell carcinomas.

Treatment here during the 25-year period has changed from primary x-ray therapy to primary radical surgery. There were 55% cures in cases treated initially by surgery and no cures in those treated primarily by x-ray therapy.

X-ray therapy is very effective against plasmacytomas and reticulum-cell sarcomas of the paranasal sinuses. All of five cases treated with x-rays are alive and well.

Disability after surgery is minimized by suitable prosthetic appliances. All postoperative cases who are free of disease are leading reasonably normal lives.

950 E. 59th St. (37).

## REFERENCES

1. Schuknecht, H. F.: Surgical Management of Carcinoma of the Paranasal Sinuses, Laryngoscope 61:874-890 (Sept.) 1951.

2. Tabb, H. G.: Carcinoma of Antrum: Analysis of 60 Cases with Special Reference to Primary Surgical Extirpation, Laryngoscope 67: 269-341 (April) 1957.

3. Appleman, R. M.: The Prosthetic Repair of Defects of the Maxilla Resulting from Surgery, J. Prosth. Dent. 1:424-437 (July) 1951.

# Studies on the Reactivity of the Mesenchyma of the Paranasal Sinuses

JAN MALECKI, M.D., Poznań, Poland

## Introduction

During the period when the attention of laryngologists was chiefly focused on problems related to the structure and function of the epithelium of the mucous membrane, Schade [3] had already published his physicochemical works. He stressed the significance of the connective tissue layer and the importance of its relation to the cell. However, in our branch of medicine, his reasearch on the antagonisms in swelling between the basal substance and the collagen fiber, on the one hand, and between the cell and the connective tissue as a whole, on the other, has not met with the recognition it deserved. The same applies to his studies on the physiological cycle of mesenchyma transformations and on the change in mesenchyma reactivity connected with those phenomena. A greater interest in this matter was awakened by later experiments of other authors investigating the hyaluronic acid-hyaluronidase system (Duran Reynals, 1928; Kulonen, 1951 [5]; Zabłocki, 1955 [10]). Although studies of the importance of this system for the function of the mesenchyma of the mucous membrane (Hervy and Zawistowski, 1958 [4]; Maspétiol, 1953 [7]; Messerklinger, 1955 [8]; Rawlins, 1957 [9]; Rubens-Duval, 1953) have only recently been started, they give rise to hopes of finding answers to some problems unanswered so far. Of particular concern are the problems of the reactivity of the mucous membrane and of the states of mucous membrane dysfunction which, as is well known, depend to a certain degree on the hormonal system, which, in its turn, is a directing factor for the hyaluronic acid-hyaluronidase system.

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Our research concerns the reactivity of the mesenchyma under definite experimental conditions. With a view to trying to find an answer to some facts established clinically, we compared experimental results with clinical observations, the experiments being carried out on dogs.

## Method

### *First Experiment*

A total of 34 frontal sinuses of 17 dogs were operated upon.

With five of them, the experiments of other workers (Samoylenko, 1913; Walsh, 1943) have been repeated, with the difference that after six to eight weeks of observation injections of a solution of hyaluronidase, 50μg., were administered directly into the postoperative scar for six days. In this group, the mucous membrane was removed entirely from the left sinus (under threefold magnification with use of Gullstrand's magnifying glasses), whereas on the right side, little islets of mucous membrane about 3×3 mm. in size were left.

### *Comment*

1. There is a possibility of complete obliteration of the frontal sinus of dogs provided that the mucous membrane is entirely removed; this observation confirms experiments of other authors. 2. When injected into the scar during the period of its formation, hyaluronidase has an inhibiting effect on the formation of compact connective tissue.

### *Second Experiment*

With the remaining 12 dogs, experiments were carried out in the following manner: From the right sinus the mucous membrane was removed only in the region where it passed into the nasal cavity; from the left sinus, the membrane was removed completely. Of 12 dogs, 8 had sinuses opened from two separate incisions in the skin and periosteum directly over the respective frontal sinus. The remaining four dogs had the skin incised only in the medial line; only after the

skin was laid open was the periosteum pushed aside, so as to avoid its being damaged over the future osseous defect. Similarly, at the end of the operation, the suturing of the periosteum was followed by a separate suturing of the skin.

Beginning with the eighth postoperative day and lasting for five weeks, six dogs were given intramuscular injections of cortisone in doses of 5 mg. per kilogram of body weight for five days of the week and 25 mg. of corticotropin (ACTH) on the sixth day. Dog No. 14 died, on the fifth day after the first operation, of septicopyemia.

*Comment*

1. The location of the incision on the periosteum has a marked effect on the degree of the cicatrization of the postoperative aperture in the bone of the anterior wall of the sinus; in other words, in dogs whose periosteum remained intact over the osseous defect, the openings diminished sooner (from 10 mm. to about 0.5 mm.) than in those whose periosteum was sutured over the osseous defect (from 10 mm. to 2-3 mm.). The growth of connective tissue into the cavity of the sinus was also hardly noticeable in these cases. 2. Of the 11 frontal sinuses, where the mucous membrane had been destroyed only in the region where it passed into the nose, communication with the nasal cavity was maintained in only five cases. In one case the sinus contained an abundant quantity of mucopurulent matter; in the remaining five cases the sinus cavity was filled with a dark-brown thick mass of mucus of such consistency as to make possible its removal in one lump by pincers. When subjected to the action of hyaluronidase the lump liquefied in the course of six to eight hours. A characteristic point is that, of the six dogs treated with cortisone and corticotropin during the postoperative period, five developed mucoceles in the sinuses. 3. The cavities of the sinuses totally deprived of mucous membrane underwent a considerable reduction through the apposition of bone; i. e., the administration of hormones did not affect the activity of the osteoblasts. Whatever remained of the cavity was filled with compact connective tissue, whereas, in animals subjected to the action of cortisone and corticotropin, the anterior bottom section of the sinuses remained free and was covered with a regenerated mucous membrane.

## Comment

As is well known, sinuses, particularly frontal sinuses, tend to show excessive fibroblastic reactions after operations. These may thwart the intended results of the best-conceived and executed operations. Our recent clinical observations show that one of the factors capable of reducing the extent of such reactions can be the transfer of the incision of the periosteum to a spot outside the site for the intended osseous defect, as was done in the case of the above-mentioned experiments with dogs. Notwithstanding that, it is generally preferable to avoid external operations on frontal sinuses and to open them by means of de Lima's method instead of by the latter method. The operative passage from the ethmoidal sinuses to the frontal sinuses meets osseous plates covered on both sides with mucous membrane only, which undoubtedly assists in avoiding the above-mentioned reactions.

As to the origin of the mucoceles in the dogs, it looked as though some factor had prevented the conversion of the mucous-secretion granules from the gel state to the solution state. It is not yet known exactly what factor (an enzyme?) is the cause. However, in histological preparations of mucous membrane from persons with atrophy, I noted a decrease of metachromatic substances if, before a section was made, a solution of hyaluronidase was introduced into the nasal cavity, as had already been done earlier by Messerklinger.[8] This decrease was also visible in the glands, though gland secretion cannot, as a rule, be considered a substratum of hyaluronidase. At least two factors must have been involved in the occurrence of the mucoceles in dogs, i. e., the partial removal of the mucosa and the injection of hormonal preparations, since in other dogs where there was no coincidence of those two factors the mucoceles did not appear. As cortisone is considered an an-

tagonist of hyaluronidase, the question arises whether it helped bring about those extremely viscous mucous clots. In human pathology, the blocking effect of such mucous lumps and the pain connected with them are not always properly appreciated. For instance, in the frontal sinuses, previously punctured by Beck's method and reoperated on because of obstinate headache, I sometimes found large clots of mucus completely blocking the opening of the frontonasal duct; after their removal, the passage was completely free. Although the presence of clots of mucus does prove a dysfunction of the mucous membrane, nevertheless the swelling of that membrane is insignificant, and it cannot, in such cases, be considered the cause of the pain. The mucous lumps taken from the sinuses of those patients and smeared in a thin layer on the walls of a test tube were dissolved under the action of hyaluronidase in a concentration of 50 units/10 ml. of 0.9% NaCl in the course of about 6 minutes. There are no reasons for supposing that the action of hyaluronidase in vivo should be less favorable than that in vitro. Therefore, the administration of corticosteroids alone immediately after operations on the frontal sinus in which the mucous membrane was left may give rise to some objections. One ought then to consider also hyaluronidase, which could be injected directly into the cavity of the sinus in the early postoperative period. On the other hand, I see no objection to administering cortisone after operations to patients whose mucous membrane has been entirely removed from the frontal sinus, since excessive granulation is thus inhibited and better conditions for the epithelium layer are created.

The introduction into the organism of both hormones and enzymes, with a view to correcting pathological reactions of the mesenchyma, can be only temporary and of short duration. An equally important task in certain specific situations may be the exclusion of such states of stress as could unfavorably affect the balance in the hyaluronic acid-hyaluronidase system. The significance of that system as an important component of the connective tissue of the mucous membrane is established; equally well known is its instability, manifested among other things by the decomposition of the mucoprotein particles in pathergical (Rubens-Duval and Maspétiol [7]) or allergical processes (Celestino and Crifó, 1954) and by the irregularity in the occurrence of this phenomenon (Messerklinger [8]). In our histological preparations stained by Feyrter's method, I noticed in such cases a quantitative reduction of the metachromatic substances, particularly in the subepithelial layer and immediately under the vascular endothelium, with their simultaneous increase in the glands and the epithelial layer of the mucous membrane. However, the degradation of the mucoprotein particles and the liquefaction of the basic substance can also take place as an effect of other stimulants, for instance, psychogenic ones.

It seems that these problems have not been sufficiently taken into account in practice so far. For instance, in cases of paranasal sinuses we are usually satisfied with the disappearance of clinical symptoms without tracing the further fate of the mucous membrane. However, besides local treatment aimed at creating favorable draining conditions, it might be necessary in particular cases to apply remedies capable of stimulating the healing tendencies present in the mesenchyma. Those tendencies could have been temporarily inhibited; besides, they are not identical in different patients. The different character of the reactions to chemical stimuli (Małecki, 1957 [6]) concerns equally the time of appearance of the first symptoms of cellular reaction, of its retreat, and of the appearance of the first collagen fibers.

Hence, the attempts at normalizing the reactivity of the mesenchyma, whether by means of regulating life conditions or by creating suitable climatic contrasts and bringing about a change of a general vascular reactivity or by careful hormonal therapy, can be at least as important as operative

treatment in creating conditions for local healing.


## Summary

The present paper presents experimental data on 17 dogs whose frontal sinuses were opened and the mucous membrane removed either completely or only in the region of the ostium; to 6 of them cortisone and corticotropin (ACTH) were administered. A distinct effect of any lesion of the periosteum over the osseous defect on the course of the healing was observed. Mucoceles formed in the sinuses of five of the six dogs to whom hormonal therapy was applied and whose mucous membrane had been only partly removed. Cortisone had also a checking influence on fibroplasia. The observations are discussed, and the results of experiments are compared with clinical observations and histochemical data on the mucous membrane of humans.


Mazowiecka 1.

## REFERENCES


1. Celestino, F., and Crifo, S.: Sulla distribuzione dei mucopolisaccaridi acidi nella mucosa nasale umana fetale, adulta normale e in condizione allergiche, Clin. otorinolaryng. Roma 6:608-623, 1954.

2. Hartmann, F., and Fricke, G.: Experimentelle Beiträge zur Struktur und Funktion gesunden und kranken Bindegewebes, Zeitschr. Rheumaforsch. 16: 65-76, 1957.

3. Häbler, C.: Physiko-chemische Medezin nach Heinrich Schade, Dresden, Theodor Steinkopff, 1939.

4. Hervy, T., and Zawistowski, St.: Badania cytochemiczne mukopolisacharydów Report 24, Congress of the Polish Otolaryngologists, Gdansk, May 17-19, 1958.

5. Kulonen, E.: Studies on Hyaluronic Acid and Hyaluronidase in the Animal Organism, Acta physiol. scandinav. (Supp. 88) 24:1-100, 1951.

6. Malecki, J.: Histological Studies on the Reactivity of the Nasal Mucous Membrane, Acta otolaryng. 47:258-261, 1957.

7. Maspétiol, R.; Rubens-Duval, A., and Chauvet, R.: La sinusite maxillaire chronique de l'enfant, Semaine hôp. Paris 29:3163-3167, 1953.

8. Messerklinger, W.: Über das Hyaluronsäure-Hyaluronidasesystem in der pathologischen Physiologie der Schleimhäute der oberen Luftwege, Zeitschr. Laryng. Rhin. Otol. 34:223-230, 1955.

9. Rawlins, A. G.: Observations on Collagen Disorders of the Upper Respiratory Tract, Ann. Otol. 66:706-709, 1957.

10. Zablocki, B.: Badania nad ukladem hialuronidaza kwas hialuronowy, Lódz, P.W.N., 1955.

# Personal Observations of Stapes Footplate Fenestration

ALAN AUSTIN SCHEER, M.D., New York

Fenestration of the footplate of the stapes has been suggested as a routine step in the surgical rehabilitation of hearing to be used when other methods to mobilize the stapes have failed. Therefore, it should be carefully evaluated as to its potential ability to improve hearing and to the subsequent changes that may take place within the labyrinth.

The hearing improvement obtained by complete true mobilization or where part of the stapes footplate is mobilized in continuity with one intact crura has been shown to be valid by hundreds of surgeons. However, the results of the suggested "fenestra ovalis" technique for improving and maintaining hearing in otosclerosis should be reviewed.

One can in no way doubt the integrity of those proposing footplate fenestration,[1] and indeed there is no reason to. The problem lies simply in the difficult determination of what really happens at the footplate in the large group of patients who have obtained hearing with a "fenestra ovalis." For my evaluation of this surgery, the operating microscope seemed essential, since without it I felt that my sense of touch and vision were inadequate to analyze results properly. With the loop I could not see the minute fissure fracture in the footplate that opens and closes with pressure on the stapes, nor could I see the exact margin of the footplate. In other words, one cannot do precise and calculated surgery at the footplate with two and one-half times magnification. Therefore, the results obtained with low magnification in this area must be scrutinized so that they are not misinterrupted.

First it must be stated that the footplate is rarely seen in its entirety despite changes in position of the microscope or the patient's head. The attachment of the posterior crus to the footplate and the upper three-fourths of the footplate (next to the facial nerve) can usually be brought into direct view. The lower margin of the footplate (on the promontory side) is not seen except in rare anatomical situations. The attachment of the anterior crus to the footplate may or may not be visible, but it is never visualized with the regularity of the posterior crural attachment. In approximately 15% of cases no portion of the footplate or its crural connection is seen because of narrowing and deepening of the niche between the promontory and the facial nerve. There are great variations between perfect anatomical exposures of the footplate or none at all.

When the technique of fenestration of the footplate was first described it was tried in cases where the stapes could not be mobilized. "Fenestra" of various sizes and in different locations were placed through the footplate with the use of sharp picks. If the footplate was thin, the opening was made readily and could be precisely enlarged by pressure applied at its margin. If the footplate was infiltrated with otosclerosis (and this could always be determined by its opaque appearance), the resistance was such that it often felt as though the probe was being pressed against the promontory. A pick could usually be worked gradually through a thick footplate, but occasionally it fell through suddenly. When an opening into the ves-

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Department of Hearing and Speech, Manhattan Eye, Ear and Throat Hospital.

tibule was made perilymph would pulsate up through it. Occasionally a fragment of footplate would fall inward toward the vestibule but still remain with a hinge-like attachment to the fixed edge of the footplate. Frequently, when the fenestra was being created, a linear fracture would extend from it in a horizontal or perpendicular direction. This fracture always happened inadvertently along the line of least resistance, beginning at the point where the pick went through the footplate.

Now, what are the results of simply making a hole in the footplate?

One hundred cases were studied including those where an opening was made inadvertently through the footplate while an attempt was being made to free it. In many of these, instrumentation later resulted in a mobile stapes. Also included were cases where the incus and crura were removed, giving a direct exposure of the footplate. In all of these cases, the footplate remained fixed at the time of the fenestra ovalis. The vast majority (96 cases) gave no clinical response to indicate there was improved hearing. Four patients did obviously hear better at the time of the opening. This was a completely unpredictable response, since neither the location nor the size of the opening could be determined to be responsible for this phenomena. Unquestionably, there are many variable factors in some sort of a mathematical relationship that are responsible for the improved hearing.[2] However, one is absolutely unable to control the response, as is evidenced by its infrequent occurrence.

The four patients whose hearing did improve were estimated to be at 20 to 30 db. level with the drum opened (operating room audiometry was not performed). When the drum was replaced, the hearing diminished appreciably, with the exception of one patient. In every instance the initial improvement in hearing was lost in three to eight days after surgery.

Two of these four patients in whom this phenomenon was observed were reoperated on (three months after the original surgery). At the time of both revisions (the incus and crura had been removed at the original surgery) complete bony obliteration of the previously large openings in the footplate was noted. Sharp picks were used to reopen the original fenestra into the vestibule, and in each case the hearing rose to the previous high clinical level that had been obtained with the first fenestra. The hearing of the first patient dropped when the drum was replaced. The posterior half of the tympanic membrane was removed in an effort to leave the oval window exposed. Nevertheless, at the end of one week, the area of the oval window was completely covered with a thick membrane and the hearing was again down to its preoperative level, where it remained after complete healing with a dry middle ear. In the second case that was revised, the patient heard at a 15-20 db. level for two days with the drum in place despite the absence of an ossicular chain. Hearing lasted two days at this level and then diminished to the 35 db. level, where it has remained.

The phenomenon of hearing through an opening in the footplate is indeed rare, but, when it can be made to happen again after bony closure in the same two patients, it would suggest that other factors are present besides simply exposure of the vestibule.

Openings through the footplate, accurately made, will not damage the hearing or the labyrinth. However, such openings cannot always be precisely made when excessive pressure must be applied to a thickened footplate that has the resistance of ivory hard bone. Complications may occur if the delicate structures that lie within the vestibule are injured when there is persistence in instrumentation in an effort to make a fenestra yield hearing. The three most frequent complications are as follows:

1. Prolonged and incapacitating vertigo is the most frequent result. Damage to the saccule and utricle will cause long-standing vertigo whenever the position of the head is changed. This has been observed many weeks after surgery.

2. Further deterioration of hearing can result from labyrinthine damage. I have never observed a total loss of hearing from traumatic labyrinthitis;

most usual is the 10 to 20 db. drop. However, these 10 to 20 db. can be the critical amount so important to a person who already has a 65 or 70 db. loss. The use of the phone and the effectiveness of the hearing aid are diminished, and if the opposite ear is already poor the patient is in a bad situation.

3. Tinnitus which is constant and very disturbing has resulted from penetration into the labyrinth.

Opening of the footplate, with exposure of the labyrinth, is being accepted as a useful surgical procedure and is being tried by surgeons with very little knowledge of the area in which they are working. True, in the rare case hearing may result temporarily in a most unpredictable manner, but is it reasonable for a surgeon to do a procedure which has a very small chance of success percentagewise and no chance of maintaining that success? Considering that damage to the labyrinth may prevent a future successful fenestration of the horizontal semicircular canal, one must come up with the answer that fenestration of the stapes footplate is not one which the otologist should practice.

As Bellucci [3] notes, the surgeon doing mobilization surgery should not feel compelled to produce hearing in all cases at all costs.

Previous publications [4,5] have indicated that, when the hearing improves as a result of stapes surgery, it has been obtained when one of the following situations occurs:

1. When the entire stapes becomes mobile without fracturing.

2. When the footplate is mobile and the crura are fractured but remain in contact with the footplate.

3. When a fracture through one crus and the footplate exists, so that the remaining crus is attached to a major portion of the footplate.

In all three situations, there is always continuity of the ossicular chain, which is essential for lasting improvement of hearing.

What, then, is happening at the footplate in the large group of cases that are obtaining results with the "fenestra ovalis" technique? First it must be realized that rarely can an opening in the footplate be noted with a loop when the crura are in continuity, and so the surgeon cannot be sure of what he has done, where it was done, or what has happened. Actually what is happening, unknown, at the footplate when hearing improves is easily observed with the microscope.

1. Pressure on the solid portion of the footplate may result in freeing the entire stapes.

2. Pressure on the footplate may result in mobilization of the footplate either as a whole or in multiple pieces, plus fractured crura, but where continuity is still retained by contact.

3. The most frequent result is one in which Fowler's [6] anterior crurotomy technique is accidently obtained. A fenestra is made in the footplate, but there is also a fracture line extending from it to the margin of the footplate. The hearing improvement is due to transmission down one of the intact crura (usually the posterior crus) to a large piece of footplate that has become mobile.

## Summary

The theory of ossicular conduction of sound stands unaltered, although in rare, unpredictable, unexplainable circumstances an opening through a fixed footplate will temporarily improve hearing to a 10-15 db. level. It has been the purpose of this paper to review my observations in a series of 100 cases where the footplate was fenestrated. In my hands the results seem to indicate that such a planned procedure is not a practical one to be used as a routine operative technique or as an alternative when true mobilization of the stapes fails.

522 West End Ave. (24).

## REFERENCES

1. Rosen, S.: The Developments of Stapes Surgery After 5 Years, A. M. A. Arch. Otolaryng. 67:129-141, 1958.

2. Goodhill, V.: Personal communication to the author.

3. Bellucci, R. J.: A Guide for Stapes Surgery Based on a New Classification of Otosclerosis, Laryngoscope 68:741-759, 1958.

4. Scheer, A. A.: Advances in the Stapes Mobilization Operation for Otosclerotic Deafness, New York J. Med. 58:191-194, 1958.

5. Scheer, A. A.: Further Development of the Mobilization Operation, A. M. A. Arch. Otolaryng. 67:152-155, 1958.

6. Fowler, E. P.: Histopathology of Ankylosis of the Stapes Footplate, Tr. Am. Acad. Ophth. 61:147, 1957.

# The Value of Systemic Hemostatic Drugs

*A "Double Blind" Evaluation of Agents Used to Increase Coagulation During Tonsillectomy and Adenoidectomy*

**SJARIF THAJEB, M.D., Jakarta, Indonesia; MUZAFFER KURKCUOGLU, M.D., and ARTHUR E. McELFRESH, M.D., Philadelphia**

Drugs presumed to increase the coagulation of blood or to increase the strength of capillaries are frequently used prior to tonsillectomy or adenoidectomy without indictation that the patient requires or, indeed, benefits from them. The interpretation of results obtained from these agents is necessarily based upon subjective evaluation, since accurate measurement of bleeding during the operative procedure is difficult. The physician tends to be influenced in subjective evaluations by his conception of the anticipated results; no results have been found of a "blind trial" of coagulant agents, in which the surgeon was unaware of whether the drug to be tested or a placebo had been given.

The present report concerns such a "blind trial" of three agents commonly employed to reduce bleeding during tonsillectomy and adenoidectomy. The agents evaluated were (1) a combination of oxalic and malonic acids (Koagamin), (2) adrenochrome monosemicarbazide (Adrenosem) and (3) intravenous estrogens (Premarin).

Oxalic and malonic acids are said to increase the speed of coagulation and to shorten the clotting time; the mechanism of their action is not known.[4,5] No objective evaluation of their effect is available.

Adrenochrome is similar in chemical structure to epinephrine but does not have the vasoconstrictive and hypertensive properties of this drug. Its hemostatic effect is said to be upon the intracellular substances of the capillaries.[1,2] The effects of this drug upon bleeding during identical bilateral dental procedues in which adrenochrome was employed on only one side have been reported by Perkins.[3] The surgeons were aware that the drug had been given; they thought that there was less hemorrhage when adrenochrome was used.

The parenteral use of estrogens to improve hemostasis is based upon their ability to increase the proaccelerin (labile factor, Factor V) content of the blood and to decrease the antithrombin level. This effect is demonstrably beneficial when there is a reduction in prothrombin or Factor VII (proconvertin), but it has not been shown to be of benefit when there are normal coagulation mechanisms.[6]

## Methods

All agents were administered in the doses and at the times recommended by the manufacturers. Either the test drug or a placebo which was identical in appearance was administered by one of us or by a member of the anesthesia staff, without the otolaryngologist being aware of what had been given. The administration of placebos continued during the entire trial period in order that changes in the resident staff or incidence of upper respiratory infection would not influence the results. The otolaryngologist who performed the tonsillectomy and adenoidectomy evaluated the degree of hemorrhage according to the following scoring system: (1) greatly increased bleeding, (2) definitely increased bleeding, (3) average bleeding, (4) definitely less than usual bleeding, and (5) unusually dry procedure.

Any bleeding which occurred in the first 24 hours postoperatively automatically converted the patient's score to No. 1 by the above scale.

The agents tested were given according to the following scheme:

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From St. Christopher's Hospital for Children and Temple University School of Medicine.

*Results of Double-Blind Study of Hemostatic Agents Administered Prior to Tonsillectomy and Adenoidectomy*

| | Oxalic-malonic Acid | | Oxalic-malonic Placebo | | Adreno-chrome | | Adreno-chrome Placebo | | Estrogen 10 Mg. | | Estrogen 20 Mg. | | Estrogen Placebo | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Greatly increased bleeding | 4 | 11 | 1 | 5.5 | 1 | 3.3 | 1 | 2.0 | 2 | 6.2 | 0 | 0 | 3 | 9.3 |
| Definitely increased bleeding | 9 | 25 | 4 | 22 | 14 | 42 | 11 | 35 | 6 | 19 | 3 | 18 | 5 | 16 |
| Average bleeding | 14 | 39 | 6 | 33 | 12 | 36 | 22 | 45 | 16 | 50 | 4 | 52 | 13 | 40 |
| Definitely less than usual bleeding | 9 | 25 | 6 | 33 | 5 | 16 | 8 | 16 | 8 | 25 | 4 | 24 | 8 | 25 |
| Unusually dry procedure | 0 | 0 | 1 | 5.5 | 1 | 3.3 | 1 | 2.0 | 0 | 0 | 1 | 6 | 3 | 9 |

| | Amount | Route |
|---|---|---|
| Oxalic and malonic acid | 2 ml. | I. M. |
| Adrenochrome | 5 mg. | I. M. |
| Estrogens | 10 mg. | I. V. |
| Estrogens | 20 mg. | I. V. |

All drugs were given approximately one hour prior to operation, with the exception of the 20 mg. dose of estrogen, which was given immediately prior to operation.

## Results

The results of the observations are shown in the Table, where the number and the per cent of patients in each of the scoring categories is shown for each drug and its placebo. Since the scoring system used is an arbitrary one, these data cannot be evaluated by statistical methods. Nevertheless, it is evident that the surgeons were completely unable to determine whether a test drug or a placebo had been given.

## Comment

The use of any drug requires careful consideration of the indication for its administration. Any one of the agents tested may be of benefit in patients with hemorrhagic diatheses; they have not been evaluated for such patients in this study. Hemostatic agents should be used routinely in persons with normal coagulation only when there is unequivocal evidence of their benefit. Objective evaluation of bleeding during a tonsillectomy and adenoidectomy is impossible; the evaluation must be subjective. When a subjective appraisal of the degree of hemorrhage is made, only a procedure in which the surgeon is not aware of whether a drug or a placebo has been given is valid. Such a study has failed to show benefit from the agents which we have tested when they were used routinely prior to tonsillectomy and adenoidectomy. Similarly, doubt must be cast upon the value of the routine administration of such agents prior to any surgical procedure to a person with normal hemostatic mechanisms.

## Summary

A "double blind" study was performed to determine whether the administration of oxalic and malonic acid, adrenochrome, or estrogens would reduce the extent of bleeding during tonsillectomy and adenoidectomy. The study has failed to show such an effect from any of these agents when compared with the effect of administration of a placebo.

This study was partially supported by a grant from Ayerst Laboratories. We should like to thank Ayerst Laboratories, The S. E. Massengill Company, and Chatham Pharmaceuticals, Inc., for generously furnishing both the drugs and the placebos used in the study. The cooperation of the Department of Otolaryngology of St. Christopher's Hospital for Children is gratefully acknowledged.

St. Christopher's Hospital for Children, 2600 N. Lawrence St. (33) (Dr. McElfresh).

## REFERENCES

1. Sherber, D. A.: The Control of Bleeding, Am. J. Surg. 86:331, 1953.

2. Peele, J. C.: Adrenosem in the Control of Hemorrhage from the Nose and Throat, A. M. A. Arch. Otolaryng. 61:450, 1955.

3. Perkins, R. E. L.: A Clinical Investigation of Adrenochrome Monosemicarbazone Sodium Salicylate, Oral Surg. 10:230, 1957.

4. Blain, A. W., and Campbell, K. N.: Hemostatic Effect of Oxalic Acid, Arch. Surg. 44:1117, 1942.

5. Steinberg, A., and Brown, W. R.: A New Concept Regarding the Mechanism of Clotting and the Control of Hemorrhage, Am. J. Physiol. 126: 638, 1939.

6. Johnson, J. F.: Changes in Plasma Prothrombin, Ac-Globulin, and Antithrombin Concentration Following Intravenous Administration of Estrogens, Proc. Soc. Exper. Biol. & Med. 94:92, 1957.

# Otosclerosis*

*An Index of the Literature, with Abstracts, and an Index of the Authors According to Subjects for 1956-1957*

This, the ninth installment in loose-leaf form perforated for insertion in Volume IV, "Otosclerosis," covers the literature for the years 1956-1957 and is published by the Central Bureau of Research of the American Otological Society, Inc. As in previous years, it also contains a few abstracts not obtainable in time for the prior index. All prior volumes of "Otosclerosis" are out of print.

Both original articles and abstracts in the various medical publications have been utilized in preparing this installment.

Only the opinions of the authors are given, and no endorsement or condemnation should be inferred because of the selection of the articles abstracted. So many papers on the fenestration and stapes mobilization operations have been published and have become so repetitive in character that we have abstracted but a few.

A reprint of this installment, with index of authors according to subjects and perforated for loose-leaf binding in Volume IV of "Otosclerosis," may be obtained for $1 from

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## Index of Authors According to Subjects: Literature of 1956-1957 and Delayed Abstracts

### Etiology, Incidence, Heredity, Environment, Emotional and Vascular Factors, Hormones, Osteogenesis Imperfecta


Antoli-Candela Cebrián, F.
Blahös, J.
Bosman, W. H., and DeBoer, W. G.
Cheng, H. L., and Chu, T. C.
Das Gupta, B. K.; Sen, G. C., and Basu, R. K.
Horiguchi, S.; Ouchi, Y., and Tsunoda, G.
Keats, T. E.
Vyslonzil, E.


### Identical Twins


Salomone, P.


### Anatomy, Histology, Physiology, Pathology, Laboratory Techniques


Basek, M., and Fowler, E. P., Jr.
Fowler, E. P., Jr.
Hladký, R.
McLean, F. C.
Ruedi, L.
Schajowics, F., and Cabrini, R. L.
Zabrzewski, A.


### Metabolism, Rh Factor, Blood Chemistry, Blood Pressure, Spectroscopy


Herrmann, A., and Maurer, H.
Hlaváček, V., and Opplt, J.
Iengo, M., and Vitto-Massei, P.
Vyslonzil, E.


### Mechanical Factors, Traumatism, Experimentation, Instruments


Engstrom, H., and Lidén, G.
Frenckner, P.
Selye, H.
Zwergius, E.


### Diagnosis, Symptomatology, Prognosis Tests, Indications for Fenestration and Mobilization Operation, Roentgenograms, Audiograms, A. C. and B. C.


Belluci, R. J.
DeCampos Henriques, J. A.
Dudok DeWit, C. A., and Spoor, A.
Escher, F., and Wyss, E.
Farrior, J. B.
Holmgren, L.
Lindner, G.
Miskolczy-Fodor, F.
Moritz, W.
Pick, E. I.
Söhoel, T.


### Treatment, Operative: Problems, Statistics, Training, Anesthesia, Bleeding, Techniques, Sequelae, Results, Speech and Pure-Tone Tests, Etc.


Alexander, L. W.
Anthony, W. P.
Antoli-Candela Cebrián, F.
Antoli-Candela, F.; Bauxauli, G., and Fernandez Urraca, F.
Antoli-Candela, F.; Antoli-Candela, F.; Olaizola, F., and Bauxauli, G.
Barajas García Ansorena, J. M.
Basek, M., and Fowler, E. P., Jr.
Basterrechea Zubieta, C., and Bertrán Escanaverino, R. E.
Bellucci, R. J.
Bertrán Escanaverino, R. E., and Basterrechea Zubieta, C.
Borri, G., and Pasini, C.
Bozzi, E.
Buchheim, G.
Charland, R.
Chiang Ssu-Ch'ang, and Liu Chien-Ch'u
Derlacki, E. L.; Shambaugh, G. E., Jr., and Harrison, W. H.
Dworacek, H.
Evaristo Moreira, F.
Frankel, G. W.
Heermann, H.
Hoogland, G. A.
House, H. P.
Hutchinson, C. A.
Kinney, C. E.
Kos, C. M.
Lempert, J.
Lillie, J. C.
McKenzie, W., and Rainer, E. H.
Martin, H.
Meurman, Y.
Meurman, O. H.
Miszke, A.
Myers, D., and Ronis, B. J.
Myerson, M. C.
Penha, G.
Perone, P. M.
Poncet, E.
Portmann, M., and Claverie, G.
Portmann, M.; Claverie, G., and Pradeaux, P.
Ramón Mozota Sagardía, J.
Ramoz Calvo, R.
Rosen, S.

Rosen, S., and Bergman, M.
Sadé-Sadowski, N.
Salomon-Danic, J.
Scheer, A. A.
Shambaugh, G. E., Jr., and Derlacki, E. L.
Siirala, U.
Smith, J. B.; Sullivan, J. A., and McAskile, K.
Tabb, H. G.
Venker, J.
Vento, V., and Torres, I.
von Schulthess, G.
Vyslonzil, E.

Treatment, Nonoperative: Vitamins, Prostheses, Statistical Studies, Ultrasonics, Medication

Anthony, W. P.
Carhart, R., and Shambaugh, G. E., Jr.
De Stefani, G. B.
Ferreri, G.
Myerson, M. C.

Résumé, Reviews, Critiques, Bibliographies

Goodhill, V., and Holcomb, A. L.
Harbert, F.
McKenzie, W., and Rainer, E. H.
Meltzer, P. E., et al.
Petersen, F. F.
Pruvot, M.
Sanderson, B. A.
Scheer, A. A.
Solero, C.
Zangemeister, H. E.

**Alexander, L. W.**: Mobilization of the Stapes in Otosclerosis by a Transtympanic Techinque, A. M. A. Arch. Otolaryng. 66:383-390, 1957.

**Anthony, W. P.**: Delayed Hearing Improvement Following Fenestration, A. M. A. Arch. Otolaryng. 64:537-538, 1956.

The author reports a short-lived improvement in hearing following an uncomplicated cupola technique fenestration operation. However, two years later, although the hearing diminished to slightly below preoperative levels, it returned to the 30 db. level and has since remained at an average 27 db. level in the frequencies most important for speech. No explanation for this phenomenon is suggested other than the possibility that fibrous tissue closed the window but later thinned out, allowing a better sound transmission.

**Anthony, W. P.**: Skin-Graft Repair of Large Perforation After Fenestration, A. M. A. Arch. Otolaryng. 65:43-44, 1957.

The author obtained an improvement in hearing following a successful operation. Two years later this improvement was lost because of an acute suppurative otitis media with a large perforation of the drum membrane. This perforation was later successfully repaired by a full-thickness skin graft, with a restoration of adequate hearing.

**Antoli-Candela Cebrián, F.**: Histology of the Labyrinthine Capsule, Pathological Anatomy of Otosclerosis: Symptoms and Evolution of the Process, Rev. españ. oto-neuro-oftal. 14:335-343, 1955.

The histopathology of a focus of otosclerosis removed from the anterior third of the external semicircular canal during the fenestration operation is described with comments concerning its evolution and the symptoms.

**Antoli-Candela Cebrián, F.**: Surgery of Hearing: Personal Technique for Otosclerotic Deafness, An. soc. otorinolaring. andaluzza. (5th Meeting) pp. 135-139, 1955.

The author uses general anesthetic and controlled hypotension in a modified technique of Lempert's and Shambaugh's surgical techniques. He has reduced the mastoid approach to an anterior atticotomy and makes his window stepwise, its facial border being left lower than the mastoid level. He claims better immediate and later results with these techniques.

**Antoli-Candela, F.; Bauxauli, G., and Fernandez Urraca, F.:** Modified Fenestration Techinque: Results, Rev. laryng. 77:516-536, 1956.

The authors have modified the Lempert-Shambaugh technique by using (1) general anesthesia with controlled hypotension, (2) reducing trepanning of the bone to a limited atticotomy without opening the antrum, (3) making the inferior margin of the fenestra on a deeper level than the superior margin, (4) substituting a free skin graft for the tympanomeatal flap set deep into the fenestra in contact with its inner margin. The authors believe that these modifications reduce the postoperative reactions (nystagmus, vertigo, vomiting) as well as the tendency of the window to close. They report that they obtained an improvement in 94% of their cases.

**Antoli-Candela, F.; Antoli-Candela, F.; Olaizola, F., and Bauxauli, G.:** Mobilization of the Stapes: Experimental Techniques, Rev. españ. oto-neuro-oftal. 16:97-107, 1957.

The operative techniques are described, and, in the authors' opinion, the fenestration operation should be reserved for those cases in which the mobilization of the stapes does not succeed.

**Barajas García Ansorena, J. M.:** Present State and Recent Advances in the Surgical Treatment of the Different Types of Recoverable Deafness, Bol. cult. Cons. gen. col. méd. España 19:31-37, 1956.

**Basek, M., and Fowler, E. P., Jr.:** Anatomical Factors in Stapes-Mobilization Operations, A. M. A. Arch. Otolaryng. 63:589-597, 1956.

In over 100 temporal bones obtained from fresh cadavers the motions of the normal and fixed stapes were studied, and in many instances these motions were filmed by slow-motion cinematography. The authors describe the elasticity of the crura and footplate of the stapes. They studied the Rosen procedure and endeavored to explain the successful cases under this procedure. They sought a logical solution for freeing a fixed stapes in otosclerosis and believe such a solution consists in cutting the anterior crus and breaking the fixed footplate behind the otosclerotic focus, in this way achieving stapes mobility. This mobility might be permanent, owing to the fact that there is a tendency of footplate fractures to heal by fibrous rather than by bony union.

**Basterrechea Zubieta, C., and Bertrán Escanaverino, R. E.:** Physiological Surgery in Otosclerosis, Acta oto-rhino-laring. iber-am. 7:485-490, 1956.

**Basterrechea Zubieta, C., and Bertrán Escanaverino, R.:** Our Experience of Rosen's Operation, Rev. laryng. 78:23-30, 1957.

**Bellucci, R. J.:** Present Status of the Operation for Mobilization of Stapes, Laryngoscope 66:269-292, 1956.

In spite of the fact that excellent results in certain patients are possible with use of the present techniques, the percentage of failures is large and is in great part due to poor visualization of the stapes and oval window during the operative procedures. If the pathological processes involving these structures were better understood better instrumentation might be devised to render this form of surgery more successful.

**Belluci, R. J.**: Indications for the Mobilization of the Stapes, New York J. Med. 57:3151-3155, 1957.

The author summarizes the indications for mobilization of the stapes as follows: Unless specifically contraindicated mobilization is advised as an initial procedure for all patients with clinical otosclerosis. The operation is particularly indicated when there is evidence of a weakened cochlea function, because the intact drum and ossicle assist in stimulating the weak nerve elements to the maximum. The operation is ideal for unilateral otosclerosis. There appears to be a statistical advantage for successful results in younger patients, but there is no contraindication to operating upon older patients, although naturally they have a longer history of impaired hearing. In patients with very severe degrees of hearing loss there appear to be no contraindications, since good results have been obtained in this group. The mobilization operation is also indicated when there are general physical contraindications to more extensive surgical procedures.

**Bertrán Escanaverino, R. E., and Basterrechea Zubieta, C.**: Mobilization of the Stapes in Aural Surgery, Rev. cubana oto-rino-laring. 6:22:30, 1957.

**Blahös, J.**: Osteogenesis Imperfecta. Acta chir. orth. et. traumatol. čechoslov. 24:56-63, 1957.

**Borri, G., and Pasini, C.**: Atypical Vestibular Phenomena Appearing After Fenestration, Arch. ital. otol. 68:721-728, 1957.

Two cases of fenestration are reported which were followed by a spontaneous alternating syndrome. The immediate observations and the late postoperative course of the phenomenon lead to the opinion that there had existed a transitory alteration of the hydrodynamic balance, thus allowing the cupula to respond to variations in pressure.

**Bosman, W. H., and DeBoer, W. G.**: Osteogenesis Imperfecta Congenita, Nederl. tijdschr. geneesk. 101:1212-1217, 1957.

**Bozzi, E.**: A Plastic Operation, Based on Certain Acoustic Theories, in Labyrinthine Fenestration for Fixation of the Stapes, Arch. ital. otol. 66: 681-687, 1955.

In order to circumvent the effect upon the sound waves after fenestration operations the author has devised an alteration in Wullstein's technique which makes it possible to direct the sound waves passing through the external ear to the "nova ovalis." He accomplished this by a modification of the shapes of the operative cavity. He believes that in the 11 fenestration operations with use of these techniques the results were among the best that he has obtained.

**Buchheim, G.**: Fenestration in Advanced Cases of Otosclerosis, Pract. oto-rhino-laryng. 19:25-28, 1957.

In 5 cases out of 12, all of whom were considered unfavorable for the fenestration operation, no improvement was obtained, but in 7 the results were favorable.

**Carhart, R., and Shambaugh, G. E., Jr.**: The Effect of Ointment Prosthesis on Fenestrated Ears, A. M. A. Arch. Otolaryng. 65:161-173, 1957.

The authors' controlled statistical study of the effects of ointment prosthesis on the fenestrated ear confirms the value of this procedure for enhancing the improvement in hearing after successful operations. The minimal conduction deficit to be expected is nearer 15 db. for the frequencies most useful in speech than

the 20 db. indicated by Davis and Walsh and substantiated by McConnell and Carhart. The simple procedure should be further explored, and the authors believe it will be found worthy of routine use in the majority of cases.

**Charland, R.**: Mobilization of the Stapes: New Surgical Treatment of Deafness Due to Otosclerosis, Union méd. Canada 86:556-559, 1957.

Practically no facial paralysis or other postoperative complications following a mobilization of the stapes have been encountered. Of course, the operative technique should be absolutely aseptic. While the external wall of the additus ad antrum is ablated, the posterior and superior regions of the middle ear should be widely exposed. Efficient local anesthesia and hemostasis are of the utmost importance. To obtain this the membranous external auditory meatus is injected in four places, namely, into the upper, posterior, inferior, and anterior walls.

**Cheng, H. L., and Chu, T. C.**: Osteogenesis Imperfecta: Report of Fifteen Cases, Chinese J. Radiol. 5:211-218, 1957.

**Chiang Ssu-Ch'ang, and Liu Chien-Ch'u**: Modified Fenestration Operation for Otosclerosis, Chinese J. Otorhinolaryng. 5:205-212, 1957.

Sixty-one cases (seventy ears) are reported, covering a period of five years. Seventy-five per cent of the patients were between 20 and 40 years of age, and five per cent were over 50 years of age. In 81.4% the hearing improved to a serviceable level, the average improvement being 25 db. in the frequencies most important for speech, and was evident within two weeks after the operation. In 28.9% the tinnitus disappeared. In 9.6% it was changed in character, and in 9.6% it was diminished in severity. In the remaining instances there was no change in the tinnitus postoperatively. Nausea and vomiting usually ceased in about 3 days; dizziness disappeared in 6 days, and nystagmus, in 10 days after the operation. There was one instance of facial paralysis, four instances of perforation of the drum membrane, two of detachment of the skin flap, and one of labyrinthitis. The main factors accounting for operative failures were improper selection of cases and lack of operative experience. A secondary fenestration operation was performed in two instances, but the improvement in hearing was maintained for only three weeks.

**Das Gupta, B. K.; Sen, G. C., and Basu, R. K.**: Blue Sclerotics with Fragilitas Ossium and Deafness, A. M. A. Arch. Ophthalmology 57:435-440, 1957.

The authors review the congenital anomaly of "blue sclerotics" and the hereditary and congenital abnormalities involved, such as multiple fractures, dislocation of joints, laxity of ligaments, deafness (van der Hoeve's syndrome), and (when it is accompanied by otosclerosis) van der Hoeve-de Kleyn syndrome. They also discuss fragilitas ossium, particularly when it is a part of the syndrome involving blue sclerae, hypermobility of joints and otosclerosis. Three types of fragilitas ossium are set forth:

(1) Osteogenesis imperfecta (Vrolik's disease, osteopsathyrosis congenita) (Looser, 1906), in which fractures occur in utero, skull changes are usually present, and early death is the rule. Both parents usually have normal bones and sclerae. (2) Osteopsathyrosis tarda (Looser, 1906), in which first fractures occur after birth, usually in childhood; the sclerae may or may not be blue, and both parents have normal bones and sclerae. It is familial but not hereditary. Cases with blue sclerae may show all the characteristics of Group 3. (3) Brittle bones and blue sclerae. In this group the first fractures occur in childhood and the sclerae are always blue. One parent always has blue sclerae, either with or without the bone affection. The condition is hereditary and may be traced as a Mendelian dominant. The fractures tend to become less frequent after puberty, when otosclerosis often appears.

The pathology, physiology, and chemistry are discussed; the serum alkaline phosphatase may be slightly elevated, "suggesting that the basic defect is not a paucity of osteoblasts but rather their inability to produce adequate matrix." Although the etiology of the syndrome is still obscure, the condition is without doubt due to some developmental error in the mesenchymal tissues; the thyroid, parathyroid, and thymus and the pituitary glands have been suspected. No sufficient variations in the values of calcium, phosphorus, and phosphatase have been found to warrant such a supposition.

A family of van der Hoeve's syndrome traced through four generations with reports of four cases is presented. The pedigree definitely shows a dominant inheritance. All four cases sustained fractures in the upper limbs before puberty. Two of the cases (Cases 1 and 4) developed slowly progressive defects in hearing after the age of 35, the cause of which is found to be due to otosclerosis. All the cases presented here have some defects in the feet. Biochemical estimation of blood revealed no increase in the serum alkaline phosphatase level. Glucose was found to be below the normal level in all cases. Slight elevation of serum potassium level and serum ascorbic acid was found in all cases.

**DeCampos Henriques, J. A.**: Clinical Aspects of Otosclerosis, Clín. hig. e hidrol. 22:237-246, 1956.

**Derlacki, E. L.; Shambaugh, G. E., Jr., and Harrison, W. H.**: The Evolution of a Stapes Mobilization Technique, Laryngoscope 67:420-447, 1957.

The authors report that the techniques evolved for stapes mobilization have yielded a 30 db. or better level of hearing in 63% of cases of "A" suitability for fenestration. However, one-half of all mobilizations in all classes of cases failed to achieve a hearing improvement comparable to fenestration, while 3.5% of the mobilizations suffered significant further hearing loss.

**de Stefani, G. B.**: Experimental Researches on Inhibition, Induced by Ultrasounds, of Bone Regeneration in Fistulae of the Labyrinthine Capsule, Valsava 31:245-264, 1955.

The author, on the basis of previous experiments on the inhibiting action of ultrasounds, used ultrasonic irradiation applied to labyrinthine fistulae in four dogs. Postoperative examinations showed that there did exist an inhibition and a marked delay in osteogenesis in these cases.

**Dudok DeWit, C. A., and Spoor, A.**: The Gellé Test, Quantitatively Performed, As a Measure for the Mobility of the Stapes, Pract. oto-rhino-laryng. 19:436, 1957.

**Dworacek, H.**: The Technique of Stapes Mobilization, HNO (Berlin) 6:163-165, 1957.

**Engstrom, H., and Lidén, G.**: Importance of the Collapsibility of the Endolymphatic Labyrinth During Fenestration Operations, Laryngoscope 67:387-394, 1957.

Based upon their studies made during fenestration and model experiments, the authors have come to the conclusion that the collapse of the endolymphatic semicircular canal during the fenestration operation is due to simple hydrodynamic forces. The clinical importance of the phenomenon is emphasized.

**Escher, F., and Wyss, E.**: Indication for Operations to Improve Hearing (Analysis of Test Cases and Atypical Otosclerosis), Pract. oto-rhino-laryng. 18:316-328, 1956.

There are no definite indications that can be tabulated for operating upon people with conduction deafness in which there is no positive history of past

infections. If there have been no episodes of otitis media in the presence of a progressive deafness, it is probable that this is due to otosclerosis, but not necessarily so in younger people. The authors recommend a two-stage operation in these indefinite cases, because at the first operation the middle ear can be examined and a decision made as to the advisability of a tympanoplastic procedure or whether a fenestration should be carried out at the second operation.

**Evaristo Moreira, F.**: Recuperation of Hearing by Stapes Mobilization, Bol. centro estud. 8:105-112, 1956.

Review of the history and techniques of the stapes-mobilization operation and a discussion of the causes of failure in this operation and in the fenestration procedures.

**Farrior, J. B.**: Fenestration Operation in the Poor Candidates (Forty-Four Cases Selected from 637 Operations), Laryngoscope 66:566-573, 1956.

Of a total of 637 fenestration operations, 44 poor candidates were selected and the results of the operations analyzed. The cases were subdivided into those with otosclerosis with a typical associated nerve loss and those with an independent nerve deafness. It is brought out that the cases which were associated with nerve deafness had obtained an average gain of about 30 db. in the speech-frequency area. This is more than can be expected with a nerve deafness independent of the otosclerosis.

**Ferreri, G.**: Vitamin A and Vitamin E in Both Otosclerosis and Progressive Deafness, Valsalva 33:207-213, 1957.

Few patients showed deficiencies in these vitamins, and the conclusion drawn was that preparations of vitamin A and E should not be prescribed in large doses to patients with otosclerosis and progressive deafness—as is sometimes the custom. The human organism is usually not lacking in these vitamins. Also their administration in excessive doses may induce intolerances and secondary effects related to the other vitamins.

**Fowler, E. P., Jr.**: Histopathology of Stapes Ankylosis, A. M. A. Arch. Otolaryng. 66:127-137, 1957.

It is the opinion of the author that in the majority of instances in which mobilization of the stapes is successful a fracture of the footplate was produced. Often in addition a fracture of the anterior crus occurs. This leaves the posterior crus connected to a mobile portion of the footplate, and the latter becomes the physiological connecting link with the ossicular chain. Therefore, a method was devised for the mobilization of the stapes by sectioning the anterior crus and fracturing the footplate posterior to the lesion. In too many cases this did not mobilize the stapes. The author showed a series of anatomical studies of the stapedovestibular relations obtained from otosclerotic patients. These studies seem to corroborate the author's previous conceptions in only about 30% of cases. In the others, although the otosclerosis was anterior, the ankylosis was present in some other part of the footplate. However, he believes that more histopathological studies of cases audiometrically tested are necessary. By such procedures it is thought that the technique of the mobilization of the stapes may be improved and better orientation obtained for evaluation and indications for the operative method.

**Frankel, G. W.**: Surgical Restoration of Hearing in Otosclerotic Deafness: Mobilization of the Stapes, West. J. Surg. 64:601-603, 1956.

**Frenckner, P.**: Stapes Mobilization: Reflections and Report of a New Instrument, Acta oto-laryng. 48:201-204, 1957.

This new instrument is an automatic, oscillating chisel, mounted on an ordinary dental drill. The amplitude of the strokes obtained varies between 0.01 and 0.12 mm., depending upon the pressure and the stroke rate, which latter is determined by both the pressure and the rpm of the drill.

**Goodhill, V., and Holcomb, A. L.**: A Study of Five Hundred Stapes Mobilizations, Laryngoscope 67:615-642, 1957.

As a primary procedure footplate fenestration frequently fails owing to early closure. However, peribasal footplate lysis with either "monopod" or "bipod" continuity with the ossicular chain is a physiologically sound procedure. The authors find that utricular vertigo is now being seen more frequently after surgery involving the footplate of the stapes.

**Harbert, F.**: Some Aspects of Fenestration, A. M. A. Arch. Otolaryng. 63: 347-350, 1956.

**Herrmann, A., and Maurer, H.**: Metabolic Examination in Otosclerosis, Arch. Ohren- Nasen- u. Kehlkopfh. 167:576-584 and 589-590, 1955.

**Heermann, H.**: Mobilization of the Stapes by Chiselling Out the Footplate and Displacing It Inwards, Ztschr. Laryng. Rhin. Otol. 35:415-421, 1956.

The author used a fine, hollow, flat chisel for the direct severance of ankylosed adhesions, leaving the unankylosed parts of the annular ligament intact. He states that the postoperative vestibular symptoms are largely dependent upon the degree of luxation of the stapes and that a completely successful mobilization may improve the hearing to 5-10 db. over the preoperative bone-conduction curve. After about two weeks, the bone conduction increases and the air conduction slightly diminishes.

**Heermann, H.**: Rosen's Method of Mobilization of the Stapes to Improve Hearing Acuity, H.N.O. (Berlin) 5:291-292, 1956.

**Hladky, R.**: Otosclerosis of the Lateral Canal and Fenestration, Československ. otolaryng. 6:89-93, 1957.

In only 3% of stapes ankylosis is a macroscopic form of otosclerosis found involving the lateral cana. There is no objection to a new fenestra if it is located directly in the usual place. The finding of an otosclerotic focus in the window region is really an advantage, because when the focus is removed one can perform an adequate fenestration operation and, in addition, use anti-inflammatory doses of x-ray immediately after the fenestration.

**Hlavácek, V., and Opplt, J.**: Research into Blood Lipoproteins in Otosclerosis, Casop. lék. cesk. 96:198-203, 1957.

The authors report that the lipoprotein spectrum seldom differs from normal in otosclerotic patients, and they could demonstrate no consistent change in the group they examined. Moreover, neither the level of protein-bound lipids nor the ratio of lipid fraction to protein fraction in the $\alpha$- and $\beta$- globulins was changed.

**Holmgren, L.**: Stapediolysis in Otosclerosis: A Physiological Approach, Acta oto-laryng. 48:219-233, 1957.

**Holmgren, L.**: Acoustical Evaluation of Factors Involved in Stapes Mobilization, Acta oto-laryng. 48:124-135, 1957.

The author states that the indications for mobilization must not be thought of as modifications of those valid for fenestration. In the fenestration operation there is considerable operative risk and stress and an expectation of postoperative improvement up to a level of social adequacy. The stapes operation involves rather small operative risks and stress. The average improvement within the area most important for speech of at least 10 db. appears to be sufficient to have justified the operation. The bone-conduction curve preoperatively should not be too much considered, because a considerable concealed reserve of capacity might be present. The mobilization operation should be performed with a minimum of trauma and until mobilization has been obtained. Postoperatively, continued inflation of the middle ear should be employed to maintain the mobility.

**Hoogland, G. A.**: Tympanotomy, Stapes Mobilization and Fenestration, Nederl, tijdschr. geneesk. 101:1865-1869, 1957.

The Miot-Rosen technique often produces excellent results. A mobilization can be tried in cases unsuitable for fenestration. The external auditory meatus approach permits inspection of the middle ear lesion prior to stapes mobilization, the fenestration operation, or tympanoplasty.

**Horiguchi, S.; Ouchi, Y., and Tsunoda, G.**: Incidence of Clinical Otosclerosis in Japan, Jap. J. Otolaryng. 58:1289, 1955.

At the Tokyo Medico-Dental Institute during the past three years the authors found otosclerosis present in 1.12% of all of the patients having impaired hearing. There were 11 male and 12 female patients in the series.

**House, H. P.**: Personal Experiences with Stapes Mobilization, Tr. Pacific Coast Oto-Ophth. Soc. 37:229-251, 1956.

The author advocates routine mobilization of the stapes as the surgical method of choice in appropriate patients with clinical otosclerosis. If the mobilization is not successful fenestration may be subsequently carried out in suitable patients. He is of the opinion that previous mobilization attempts do not interfere with a subsequent fenestration result. However, a four-month delay is recommended between these operative procedures. The methods used in mobilization are, of course, of great value in exploration of the middle ear area and are suitable in attempts to improve many types of middle ear pathology other than clinical otosclerosis. The author feels that no standard routine technique will be set up for this procedure at this time because of the variations in the anatomy of the stapes crura and footplate and in the histopathology of otosclerosis. Each case must be handled according to the individual problems it presents.

**Hutchinson, C. A.**: Bilateral Hearing Improvement Following Fenestration, J. Laryng. & Otol. 71:528-532, 1957.

In 125 consecutive fenestration operations the author observed a considerable improvement in the ear not operated on in 25 instances. In the past, other workers have made similar observations. He discusses the possible mechanism of such improvements in hearing.

**Iengo, M., and Vitto-Massei, P.**: Otosclerosis and the Rh Factor, Arch. ital. laring. 63:77-99, 1955.

Two families, three generations in each, were studied to determine the variations of the rhesus factor in otosclerosis. The results were as follows: 1. There is a definite parallelism between the two hereditary factors. 2. The hereditary character studied is independent of the sex chromosome. 3. Both the rhesus-negative factor and the otosclerosis factor are of recessive nature.

**Keats, T. E.**: Diffuse Thickening of the Calvarium in Osteogenesis Imperfecta, Radiology 69:408-411, 1957.

**Kinney, C. E.**: Statistical Analysis of the Stapes Mobilization Procedure, Laryngoscope 66:1339-1345, 1956.

**Kos, C. M.**: Mobilization of the Stapes for Improvement of Defects in Hearing Due to Clinical Otosclerosis, J. Internat. Coll. Surgeons 27:627-639, 1957.

The author reports 400 stapes-mobilization operations and analyzes them according to the improvement in hearing obtained in preoperative categories. It was shown that the degree of success was dependent upon good neural function, as revealed by the bone-condition threshold for pure tones, and upon a cochlea reserve, represented by an air-bone-conduction difference of at least 25 to 30 db. Of the 400 patients, 32% showed a considerable improvement in hearing and 22% showed a moderate but still helpful improvement in hearing. In addition, in 62 patients, 15.5% whose hearing regressed after an initial improvement were subsequently operated upon, with increasingly sustained helpful hearing. Some of the patients have been fenestrated, and others have elected to wear a hearing aid. In the 122 failures, 10 patients suffered an additional loss of 10 to 15 db. but otherwise there were no deleterious effects which might have prevented a patient from using a hearing aid with as much satisfaction as before the operation.

**Lempert, J.**: The Dry Physiologically Perfected Fenestra Nov-Ovalis Technique: A Technique for Predictable Restoration and Conservation of Serviceable Hearing in Clinical Otosclerosis, A. M. A. Arch. Otolaryng. 66:35-45, 1957.

The author recommends the abolishment of irrigation in open fistulas because a postoperative reaction of the labyrinth following the fenestration operation is said to be caused by irrigation of the open fistula cavity with isotonic or other so-called "physiological" solutions.

**Lempert, J.**: Dry Fenestra Novovalis Operation: Technique for Restoration and Conservation of Serviceable Hearing in Clinical Otosclerosis, J. A. M. A. 165:229-231, 1957.

The irrigation that appears necessary for the removal of bone dust is now done before the perilymphatic space is opened. The subsequent creation of bone dust can be avoided by removal of the bony cupola intact instead of employment of the pulverizing technique. The author performed 100 operations alternately with and without the use of irrigation. Bleeding into or within the perilymphatic space was prevented in every instance. However, there was a labyrinthitis of some degree in each of the 50 irrigated cases, but it was absent in all 50 of the non-irrigated cases. It is important that the vestibular fenestra be made in a region

out of contact with the spreading otosclerosis lesion; otherwise permanent favorable results will not be obtained; the fenestra is always made outside of the middle ear for best acoustical results, the middle ear space being acoustically sealed off, as is the newly covered vestibular fenestra. The author believes that in this way a maximum difference in sound pressure between the middle ear and the fenestra is attained and that this produces a lasting and the best possible improvement in hearing.

**Lillie, J. C.**: Results of Fenestration Operation: Supplemental Report, Proc. Staff Meet. Mayo Clin. 31:198-200, 1956.

**Lindner, G.**: The Usual Indications for Fenestration in Lempert's Clinic, H.N.O. (Berlin) 6:33-35, 1956.

**McKenzie, W., and Rainer, E. H.**: The Rosen Operation: Early Experience, J. Laryng. & Otol. 71:655-666, 1957.

This is a report by two surgeons working independently. Their results appear to be so encouraging that the authors believe the operation should be used in preference to the fenestration operation and that it is suitable for many patients who might otherwise be considered unfavorable subjects. The value of the operation from the standpoint of diagnosis of middle ear lesions is discussed.

**McLean, F. C.**: The Ultrastructure and Function of Bone, Science 127:451-456, 1958.

This article deals with the current trends in research, with special reference to the relation of the fine structure of bone to its function. "(As) the bone serves as a reservoir for the calcium ion, and to some extent for other ions, control of these ions in the blood is essential to the maintenance of a steady state in the internal environment; a combination of ion transfer and exchange in both directions between blood and bone is in constant operation." Several methods of observation and experiment have been drawn up to present a unified picture of the current state of research on the interchange between blood and bone. This article is too long and too important to be abstracted. It should be read.

**Martin, H.**: Surgery of the Footplate of the Stapes: New Technique, J. franç. oto-rhino-laryng. 6:647-651, 1957.

**Meltzer, P. E., et al.**: Symposium: The Operation for the Mobilization of the Stapes in Otosclerotic Deafness, 66:729-784, 1956.

**Meurman, Y.**: Mobilization of the Stapes After Atticotomy with Detachment of the Basis Stapedis, Arch. Ohren- Nasen- u. Kehlkopfh. 167:531-540 and 544-545, 1955.

**Meurman, O. H.**: A Study of Refenestration: Critical Survey with Description of a Method of Operation, J. Laryng. & Otol. 71:116-122, 1957.

Twenty-five fenestration operations have been carried out at the Otolaryngological University Hospital of Helsinki since 1951. With three exceptions the primary results were good. In seven cases the revision consisted in a reopening of the closed fenestra and replacing of the flap. In nine instances the hearing subsequently again receded to the preoperative level. In three instances the observation time is still too short to allow a proper opinion. In three other instances there was a partial loss of the improvement but the hearing did not quite recede to the preoperative level. In only two instances was improvement

maintained at the level of the primary result. In eight instances fenestration of the superior semicircular canal was made in connection with revision. Both the old and the newly created fenestra were covered by one fairly large Thiersch graft. In all cases the primary result was good, but in two instances the improvement was partially lost, although it did not reach preoperative levels; in the others it was maintained at the practical 30 db. level. The author states that fenestration of the superior semicircular canal gave better results than a simple revision and that a lasting improvement of hearing was obtained even in patients in whom revision had previously failed twice.

**Miskolczy-Fodor, F.**: Determination of the Hearing to be Obtained by Fenestration, Based on the Pre-Operative Auditory Findings, Acta med. acad. sc. hung. 9:15-25, 1956.

To predetermine what the hearing level will be after fenestration a new method is proposed which determines the average hearing values and those to be expected in the most favorable cases. The accuracy of the calculations can be satistically demonstrated.

**Miszke, A.**: A Controlled Decreasing of Blood Pressure During Fenestration, Otolaryng. polska 10:163-168, 1956.

Pendiomid was administered immediately before the fenestration was made in 34 fenestration operations. Blood pressure was found decreased on the average by 30-40 mg. Hg. Any bleeding from the osseous vessels almost completely disappeared.

**Moritz, W.**: The Differentiation of Combined Hearing Defects (Otosclerosis and Vegetative Hardness of Hearing), Arch. Ohren- Nasen- u. Kehlkopfh. 167:546-559 and 574-576, 1955.

**Myers, D., and Ronis, B. J.**: Improvement of Hearing in Otosclerosis by Means of Stapes-Mobilization Operation: Report of Results and Experiences, A. M. A. Arch. Otolaryng. 64:307-323, 1956.

**Myerson, M. C.**: Mobilization of the Stapes Without Incision: A Preliminary Report on Mobilization of the Stapes by Vibrations Originating at the Short Process of the Malleus, A. M. A. Arch. Otolaryng. 64:373-376, 1956.

A modification of a method, published by Lucae, in 1884, for the mobilization of an ankylosed footplate of the stapes is described. An especially designed forked instrument is applied lightly to the short process of the malleus, perpendicular to the normal axis of vibration of the ossicular chain. A flattened rod, rotating 9,000 rpm in a dental drill hand piece, is then held against the forked instrument. It was found that in the cadaver the malleus could withstand a pressure of 75 g. Further reports may be expected.

**Myerson, M. C.**: Experiences with Transossicular Mobilization of the Stapes, A. M. A. Arch. Otolaryng. 66:480-483, 1957.

Sixty-seven cases were operated upon by a simple transossicular mobilization of the stapes, with no complications or other disadvantages encountered. The author states that in especially selected cases the percentage of successes may be as high as 70. His over-all percentage of good results was 58.2. In a small percentage of cases there was a recurrence of the ankylosis. He is of the opinion that there is little or no difference between the results obtained from the transossicular mobilization technique and the open middle ear procedures.

**Penha, G.**: Otosclerosis—Some Views on Its Pathogenesis and Treatment: Fenestration—Cases Operated on Eight Years Ago, Clin. hig. e hidrol. 22:265-274, 1956.

**Perone, P. M.**: Long-Lasting Suppuration of Mastoid Cavity After Fenestration and Antro-Atticotomy: Bacteriological and Therapeutical Studies, Boll. mal. orecchio gola, naso 74:225-244, 1956.

Fifty cases of suppuration following the fenestration operation for otosclerosis and fifty following the radical or modified radical operation for chronic mastoiditis are reported. The symptomatology is reviewed, and the bacteriology and sensitivity tests made with the bacteria against the common antibiotics are discussed, particularly the therapy and the local use of antibiotics.

**Peterson, F. F.**: Modern Trends in Fenestration Surgery, South African J. Lab. & Clin. Med. 2:71-77, 1956.

**Pick, E. I.**: Indications and Predictions in Stapes Mobilization: New Method to Test Hearing During Surgery, A. M. A. Arch. Otolaryng. 65:586-590, 1957.

**Poncet, E.**: The Supra- and Retrotympanic Approach in Operations for Mobilization of the Stapes, Ann. oto-laryng. 73:938-941, 1956.

**Portmann, M., and Claverie, G.**: Surgery of the Windows of the Labyrinth in Otosclerosis, Ann. Otol. Rhin. & Laryng. 66:49-66, 1957.

The authors recall several milestones in the history of mobilization of the labyrinth windows, with many good results as long ago as 1890 by C. Miot. They describe and illustrate the pathophysiology and anatomy of the stapes. In one instance the crura of the stapes are shown fused and close together like the barrels of a shotgun, probably, in the authors' opinion, due to spontaneous fractures and otosclerosis rather than to abnormal circulatory factors. Hourglass and slit-like contractions of the windows are described and illustrated. They believe there is a tendency toward employment of a retro approach. They use a microdrill for stapediovestibular osteotomy. The cutting extremity of the rotating element is 0.2 mm. and the speed-up rotation about 10,000 per minute. Of 80 patients operated upon, 60% obtained some improvement in their hearing, and the gains were analyzed. The authors prescribe 10 to 20 mg. of Cortancyl daily.

**Portmann, M.; Claverie, G., and Pradeaux, P.**: Surgery of Windows of the Labyrinth in the Syndrome of Otospongiosis, Rev. laryng. 78:38-59, 1957.

**Pruvot, M.**: Mobilization of the Stapes: Latest Results and Comments, Acta oto-rhino-laryng. belg. 10:399-406, 1956.

**Ramón Mozota Sagardía, J.**: Mobilization of the Stapes in Otosclerosis, Clín. y. lab. 62:341-348, 1956.

**Ramos Calvo, R.**: Stapedolysis: Technical Indications and Results, Medicina, Madrid 25:267-290, 1957.

**Rosen, S.**: Results of Mobilization of Fixed Stapedial Foot Plate in Otosclerotic Deafness, J. A. M. A. 161:595-599, 1956.

**Rosen, S.**: Mobilization of Stapes (Rosen): Simple Procedure for Otosclerotic Deafness, J. Mt. Sinai Hosp., New York 23:200-226, 1956.

**Rosen, S., and Bergman, M.**: Functional Goals in Mobilization of the Stapes, A. M. A. Arch. Otolaryng. 63:11-20, 1956.

Basing their opinion on the results of 700 operations for stapes mobilization, the authors state that a higher level of hearing is obtained by this method than by any other surgical procedures. The objective is to obtain (1) normal hearing, (2) the restoration of hearing to an 11-20 db. level in those persons who have a perceptive loss so that normal hearing is not possible, (3) restoration of useful binaural hearing, (4) the removal of the conductive component in mixed deafness, and (5) facilitation of the use of hearing aids in very severe deafness. The stapes-mobilization operation may be used in cases with a hearing loss of 30 db. or less, in other words a loss not severe enough to indicate a fenestration operation.

**Rosen, S.**: Fenestration of the Oval Window for Increasing Sound Conduction to the Cochlea, A. M. A. Arch. Otolaryng. 65:217-220, 1957.

A useful instrument for fenestration of the oval window in patients with otosclerotic deafness was presented. The author claims that the hearing may be restored in deafness due to chronic adhesions or chronic suppuration by fenestration of the oval window through the stapes footplate.

**Ruedi, L.**: The Histology of Otosclerotic Ankylosis of the Stapes, with Reference to the Surgical Mobilization of the Stapes, Acta oto-laryng. 48:120-123, 1957.

**Sadé-Sadowski, N.**: Results of Six Years of Fenestration, Ann. oto-laryng. 73:566-572, 1956.

**Salomon-Danic, J.**: Fenestration and Stapes Mobilization, Ann. oto-laryng. 74:526-534, 1957.

In otosclerosis with moderate hearing loss, the author believes that mobilization should be tried before the fenestration operation. When there is complete fixation of the stapes he advises fenestration in preference to stapes mobilization.

**Salomone, P.**: Otosclerosis in Identical Twins, Arch. ital. laring. 65:351-354, 1957.

It would appear that otosclerosis in monozygotic twins is unusual. However, to the present, 17 cases have been reported in the literature, and the author reports another in this present communication.

**Sanderson, B. A.**: Modern Management of Otosclerosis, Eye, Ear, Nose & Throat Month. 36:663-667, 1957.

**Schajowics, F., and Cabrini, R. L.**: Histochemical Localization of Acid Phosphatase in Bone Tissue, Science 127:1447-1448, 1958.

An analysis of the histochemical distribution of an enzyme is a valuable method for better understanding of its physiological role. There have been many technical difficulties in localizing acid phosphatase in certain tissues, particularly in bone. The authors recently made a thorough analysis to establish the basic conditions for obtaining a satisfactory decalcification of bone in order to reveal the presence of acid phosphatase. They proved that many techniques for demonstrating this enzyme could not be successfully applied if even a vestige of calcium remained in the section. Chelating agents were employed but with no success. They found that acid phosphatase was present in large quantities in the giant

cells in the proximity of erosive bone surfaces (osteoclasts) and cartilaginous surfaces (chondroclasts). In the walls of the vessels adjacent to erosive surfaces they also found large quantities of the enzyme, and in pathological areas there was an association of the enzyme with the areas of bone reabsorption. They conclude that by use of an adequate technique for decalcification it is possible to demonstrate consistently and regularly acid phosphatase in the osseous tissues where it is intimately related to the reabsorption areas.

**Scheer, A. A.**: Observations on Five Hundred Cases of Transtympanic Mobilization of the Stapes, A. M. A. Arch. Otolaryng. 65:245-254, 1957.

The author believes that the results obtained in these cases, operated upon during the past two and one-half years, warrant the continuation of this type of surgery for the relief of deafness caused by otosclerosis. Successful results in 36% of the cases were originally obtained early in the course of this work, and no better results were obtained subsequently with use of the present operative techniques. In 25% of the patients the hearing deteriorated. However about one-half of these subsequently improved on revision.

**Selye, H.**: Acquisition of Resistance to Osteolathyrism During Adaptation to Cold, Science 126:612, 1957.

Through the mechanism of "crossed resistance," "exposure to stressors (cold, muscular exercise, trauma and infections) can inhibit the lung edema normally produced by adrenaline, the anaphylactoid reaction usually elicited by egg white or dextran, and many other types of inflammatory responses." The author believes that, since the thyroid participates in certain systemic adaptive reactions, an endogenous increase of its secretion could likewise produce a phenomenon of "crossed resistance."

Experimental osteolathyrism is a disease characterized by excessive proliferation and degeneration of bone and junction-cartilage tissue (not to be confused with the clinical lathyrism, which affects the nervous tissue selectively). This skeletal disease, which is usually induced in the rat by treatment with Lathyrus odoratus or aminoacetonitrile (AAN), can readily be prevented by thyroxin. It is well known, furthermore, that exposure to cold augments the secretion of thyroid hormone. Could this stimulation of the thyroid during adaptation to a low temperature afford protection against intoxication with aminoacetonitrile?

Experiments proved that it could do so, at least in female rats: that when AAN hydrosulfate was administered to Group 1 (the controls) kept at room temperature there developed severe osteolathyrism, with multiple exostoses at the tendon-insertion sites and with excessive periosteal bone formation, especially in the upper two-thirds of the femur. Group 2, kept at 0 C during treatment, showed only traces of such changes, and in Group 3, kept at 0 C for 10 days before and during treatment, no changes were observed macroscopically or histologically. The thyroid gland was histologically normal in Group 1 and showed cellular hypertrophy and hyperplasia in Groups 2 and 3. The author believes that the exposure to cold did cause thyroid stimulation. The experiments show among other things, "The amount and type of hormone normally secreted by the thyroid during adaptation to cold suffices to induce resistance against a severe experimental malady."

**Shambaugh, G. E., Jr., and Derlacki, E. L.**: Primary Skin Grafting of the Fenestra and Fenestration Cavity: Early and Late Results, A. M. A. Arch. Otolaryng. 64:46-49, 1956.

Primary skin grafting of the fenestration cavity using split-thickness Thiersch grafts in a series of cases did not, on the average, shorten the time of healing compared with a similar

series of cases treated by the usual sterile technique in all post-operative dressings. Primary skin grafting does result in a rough, uneven epidermal lining without a smooth subcutaneous connective-tissue layer, and this thin epidermis desquamates excessively and breaks down frequently, with recurrence of discharge and sometimes with development of attic perforations. Therefore, we advise against primary Thiersch grafting of fenestration or radical mastoid cavities as a routine measure.

Covering the fenestra with a free Thiersch graft instead of the usual pedicle flap does not decrease the postoperative serous labyrinthitis, as judged by the two-week hearing test. This method of covering the fenestra offers no advantage over the pedicle flap and should be reserved only for cases where the pedicle flap is not suitable because of surgical trauma, abnormal thickness, or other condition.

The authors state that the two-year hearing results showed little difference between the two techniques.

**Siirala, U.**: The Use of a Thiersch Graft for Covering the Fenestra and a Meatal Skin Flap for Isolation of the Pneumatic Cells and Tympanum in the Fenestration Operation, Acta oto-laryng. 47:73-80, 1957.

**Smith, J. B.; Sullivan, J. A., and McAskile, K.**: The Fenestration Operation Using Minimal Irrigation, Laryngoscope 67:643-660, 1957.

Irrigation of the perilymphatic space with isotonic saline solution may cause irreversible damage within the fenestra. Lamp's solution was used and caused less damage and less vertigo. An attempt was made to use a minimum amount of isotonic, isothermal solution only when absolutely necessary. In instances where no irrigation was used it was observed that there was an improvement in the upper frequencies and that even blood clots and chips in the perilymphatic space did not necessarily preclude a favorable result. If any clot cannot be removed with ease it is felt that it may be well to leave it in situ. The results of "100 ideal cases," which eventually showed an average loss of only 18 db., suggest that minimal irrigation is far superior to continuous irrigation. An attempt is now being made not to use any solution after removal of the fenestral lid. The closure rate appears to remain at about only 1%. The authors discuss the techniques for removal of the lid and the cupola method they employed.

**Söhoel, T.**: The Course of Bone Conduction After Fenestration Operations, Acta oto-laryng. 47:462-472, 1957.

Postoperatively the following course was observed.

1. On the first day, the bone conduction gained, on the average was 6.5 db. at 250 cps, 10 db. at 500 cps, 7 db. at 1,000 cps, 11 db. at 2,000 cps, 10 db. at 3,000 cps, and 4.5 db. at 4,000 cps. This result was probably due to an increased mobility in the perilymph and therefore an increased transmission of the vibrations to the basilar membrane. Of the patients operated upon, 80% showed an improvement in their bone conduction the first day after the operation, and all of these had a satisfactory final result, with an average gain within the speech-frequency area of 24 db. by air conduction. The author believes that this shows that a primary gain in bone conduction indicates a good prognosis.

2. A postoperative labyrinthine reaction is reflected in the bone conduction from the second day postoperatively by bone-conduction loss which increases slowly during the first six to nine days and then may disappear again in the course of three to four weeks or more, slowly in the high frequencies. In one-third to one-half of the cases the cochlea reaction was so marked that recruitment was easily demonstrated by bone conduction and was indicated also by a shifting in the audiometric Weber test with increasing intensities. However, two

patients obtained satisfactory hearing, one of whom had a considerable depression in bone conduction postoperatively, probably due to surgical trauma. In the rest of the patients the postoperative reaction was transitory, particularly in the lower and medium high frequencies.

3. Three weeks postoperatively patients obtained, on the average, an improvement in the following frequencies: 5 db. at 250 cps, 15 db. at 500 cps, 12 db. at 1,000 cps, 11 db. at 2,000 cps, 8 db. at 3,000 cps, and less than 2 db. at 4,000 cps.

**Solero, C.**: Surgery in Deafness: Stapes Mobilization in Otosclerosis, Boll. e mem. Soc. piemontese chir. 27:331-334, 1957.

**Tabb, H. G.**: Mobilization of the Stapes for Restoration of Hearing in Otosclerotic Deafness, J. Arkansas M. Soc. 53:74-77, 1956.

**Varga, G.; Farkashidy, J., and Alleram, R.**: Attempts at Prevention of Obstruction of the Artificial Bone Fistula, Fül- orr- gégeyóg. 4:116-120, 1955.

**Venker, J.**: The Reaction of the Cochlea Following a Fenestration Operation, A. M. A. Arch. Otolaryng. 63:21-24, 1956.

The author stresses the disappointment patients experience after unsatisfactory fenestration operation. He regarded 96 of his 402 fenestration cases as operative failures and studied them carefully. He considered as minor causes of failure closure of the window, faulty evaluation of indications, and damage to the membranous labyrinth. Of these unsatisfactory cases, 81 manifested labyrinth damage, and the author is of the opinion that the chief factor may lie in variations in the perilymph. He studied the differences between the perilymph and the cerebral spinal fluid and the possible sources of endolymph production. He calls attention to the fact that the isotonic salt solution used during the fenestration operation is different from the perilymph in composition and in osmotic pressure. He therefore is of the opinion that while the fistula is open the less salt solution used the better. He states that a suitable solution would be sodium chloride and sucrose at 37 C, because it is isotonic with perilymph.

**Vento, V., and Torres, I.**: Anesthesia with Controlled Hypotension (Arfonad) in Fenestration, Med. españ. 34:467-474, 1955.

Twenty cases are analyzed, and the advantages of trimethaphan (Arfonad) are set forth in comparison with other hypotensive drugs.

**von Schulthess, V. G.**: Otitis Media Acuta in Patients Fenestrated for Otosclerosis, Pract. oto-rhino-laryng. 18:360-364, 1956.

The author reports four instances of acute otitis media following the fenestration operation. In three cases the clinical signs of influenzal otitis with vertigo were observed. Infection in fenestrated ears endangers any hearing gain obtained by the operation. It commands immediate attention and can be controlled within a few days by paracentesis, antibiotic therapy, and rest in bed. On recovery, the patient's hearing acuity shows no change audiometrically, as compared with the immediate postoperative audiograms.

**Vyslonzil, E.**: Plasma Protein Examinations in Otosclerosis, Arch. Ohren-Nasen- u. Kehlkopfh. 167:584-590, 1955.

**Vyslonzil, E.**: The Behaviour of the Vestibular Apparatus in the Recently Fenestrated Labyrinth, Acta oto-laryng. 46:171-179, 1956.

The author attempts to explain the relationships between postfenestration vertigo and nystagmus, on the one hand, and, on the other hand, the pathophys-

iological lesions and reactions in the labyrinth. It is suggested that there is an initial disturbance of an osmotic character developing in the vestibular portion of the labyrinth and followed by a distinct labyrinthine stage. The permeability of the membranous labyrinth is deemed to be of special significance. The spontaneous nystagmus occurring immediately after the fenestration operation, a few days thereafter, and later is discussed. This nystagmus is not usually dependent upon the position of the head but varies in oscillation intensity, depending upon whether the ear operated on is downward or upward. The author interprets postoperative nystagmus as due to a functional loss, agreeing with Wittmaack's opinion and assuming that the changes in the membranous labyrinth engender a higher intensity in the tone of the nontreated ear.

**Vyslonzil, E.**: Changes in the Cutaneous Vessels of Otosclerotic Subjects, Ztschr. Laryng. Rhin. Otol. 35:185-192, 1956.

Vyslonzil examined histologically the skin from the external auditory meatus, of the cheeks and from the neck of a series of patients with otosclerotic deafness. His examinations revealed a marked capillary dilatation and a progressive degeneration of the papillae in the skin at all ages. There was also occasionally a dilatation of the lymphatics and a considerable infiltration zone of plasma cells, lymphocytes, and mast cells around the capillaries. With the exception of the lymphatic dilatation these findings are noted in patients at the age of 22 and upward, becoming more marked with aging. The author remarks that there is a striking similarity between the findings and the vascular changes observable in the otosclerotic bony labyrinth. He believes the cutaneous changes found in circulatorily sound hypotonics, as well as the vascular changes in the otosclerotic labyrinth, can be interpreted as being the result of stasis. He is at variance with Holmgren's opinion that certain middle and external ear pathology is the result of atrophy due to disuse. He discusses the significance of the distinctly raised albumin content of the various body fluids, including the labyrinthine in otosclerotic patients, and suggests that the latter may be due to a reduced permeability of the smallest vessels.

**Zakrzewski, A.**: Trial with Chemical Devitalization of the Osseous Wall of the Otic Capsule in the Environment of the Fenestra Novovalis in the Otosclerosis Cases, Otolaryng. polska 10:259-263, 1956.

In the Poznán Clinic during the past three years efforts were made to devitalize chemically the osseous capsule of the labyrinth immediately before fenestration operation in cases of otosclerosis. Experimental investigations upon animals were concerned with the mode of regeneration of the osseous tissues under inhibiting drugs.

**Zangemeister, H. E.**: Observations in Mobilization of the Stapes on Account of Otosclerosis, Arch. Ohren- Nasen- u. Kehlkhopfh. 167:540-545, 1955.

**Zwergius, E.**: The Mechanism of Labyrinthine Fistular Reactions: Experimental Investigations, Acta oto-laryng. 46:74-79, 1956.

It was observed that movements of a small air bubble inside the membranous ampulla in cases of labyrinthine fistulae were plainly seen to coincide in time and in direction with the movements of the oval window. It is concluded that endolymph movements in the cupular region take place as a sequel of fistular compression.

# Multicentric Origin of Glomus Jugulare Tumors

RICHARD A. BUCKINGHAM, M.D.; KENJI AIMI, M.D., and S. L. PERRELLI, M.D., Chicago

The nonchromaffin paraganglioma is a tumor that arises from the carotid and aortic bodies, from small islets of similar tissue normally located in the temporal bone along branches of the glossopharyngeal nerve in the middle ear (Jacobson's nerve), and along branches of the auricular branch of the vagus (Arnold's nerve) in the jugular foramen and temporal bone. Similar accumulations of this carotid body-like tissue lie on the nodose ganglion of the vagus and the ciliary body of the eye.[1]

The carotid and aortic bodies have a chemoreceptor function, but at the other sites this nonchromaffin tissue has no function that we know (Fig. 1).

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From the Department of Otolaryngology, University of Illinois College of Medicine, and the Illinois Eye and Ear Infirmary.

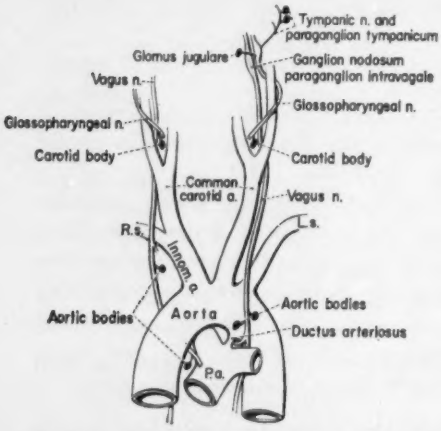


Fig. 1—Schema shows sites where nonchromaffin paraganglial tissue lies normally. Reproduced with permission from Le Compte, P. M.: Section IV, Fascicle 16, Atlas of Tumor Pathology, U. S. Armed Forces Institute of Pathology, 1951. Modified, in Le Compte, from a diagram (Fig. 26, Cancer 3:667-694, 1950) obtained through the courtesy of R. Lattes, after J. D. Boyd (contr. Embryol. Carnegie Inst. 26:1-31, 1937).

Guild [2] first described as a glomus jugularis a small 0.5 mm. collection of carotid body-like cells which lay in the middle ear in close association with the Jacobson's branch of the ninth nerve.

In 1945, Rosenwasser [3] first reported a vascular tumor of the middle ear and mastoid which resembled histologically the glomus jugularis of Guild.

Lattes and Waltner [4] pointed out that carotid and aortic bodies and the glomus jugularis are identical histologically and suggested they be grouped together as nonchromaffin paraganglia. Tumors of this tissue became nonchromaffin paragangliomas.

Although most of the reported "glomus tumors" were confined to the temporal bone, several authors have reported cases of these nonchromaffin paragangliomas situated in the ipsi- or contralateral carotid body as well as in the temporal bone.[5-7]

In 1948, Winship et al.[8] reported a case with an ear and neck lesion of the nonparaffin paraganglioma type. They felt the neck lesion was a metastasis but may have been a separate tumor of the carotid body.

The case we wish to present is somewhat different in that we found clinical evidence of a tumor of the jugular foramen which we assume to be a nonchromaffin paraganglioma arising from the glomera of the 10th nerve. We also found a separate distinct small tumor on the promontory of the middle ear at a site where Guild consistently found glomera associated with Jacobson's nerve.

After a study of 88 serially sectioned temporal bones, Guild, in 1953,[9] found on the average two and at times as many as six glomera per ear. He said that glomera

were located at different areas in the temporal bone and that tumors arising from them could cause several different symptom-complexes, depending on their location.

We were able to diagnose this tumor before the middle ear lesion could enlarge into the mastoid process or coalesce with the jugular foramen lesion.

Considering the evidence from our case and from other reports of concomitant lesions of the carotid body and temporal bone of the nonchromaffin type,[5-7,10,11] we suggest that there may be a common etiologic agent, which acts on the nonchromaffin paraganglial tissue and causes simultaneous outbreaks of tumors in different anatomical sites.

In this case, exacerbations of symptoms followed acute febrile episodes. Williams [11] et al. noted the frequency of febrile reactions preceding symptoms in their series.

Since the glomus jugulare nonchromaffin paraganglial tissue exists normally at several different places in the temporal bone, there is a possibility that extensive temporal bone lesions of this type may have arisen, as in the case we present, from multicentric areas and coalesced before they caused symptoms or before the otologist could diagnose them.

## Report of a Case

This patient was a 39-year-old Negro woman, who first came to the Illinois Eye and Ear Infirmary, in July, 1957, because of hoarseness and tinnitus of the left ear, which began after an acute febrile episode, in October, 1956. Weakness of the left shoulder was present from November, 1956.

In January, 1957, she had a spell of respiratory distress and noted difficulty swallowing liquids, again following an episode of chills and fever.

Examination at the Illinois Eye and Ear Infirmary showed deviation of the soft palate to the right, left recurrent nerve paralysis of the vocal cord, weakness of the left shoulder, and atrophy of the left side of the tongue. Optic disks were normal.

Spinal fluid pressure was 300 mm. of water. A Queckenstedt test showed a normal reaction on the left side. Compression of the right jugular vein caused no elevation of the spinal fluid pressure. Spinal fluid chemistries were normal.

Otological examination showed a small 4 mm. bluish-red lesion on the promontory of the left middle ear. We saw this through an entirely normal ear drum, which flattened the lateral surface of the tumor but was not attached to it (Fig. 2).

An audiogram and vestibular tests were normal. There were no neck masses. Complete skull and mastoid x-rays were normal.

Using Rosen's[12] technique for this type of lesion, we lifted a tympanomeatal flap and exposed a 4 mm. reddish lesion lying on the promontory of the left middle ear. Jacobson's nerve appeared to enter the lower margin of the lesion, and one small blood vessel was attached to it posteriorly (Fig. 3).

The lesion was removed with a cup forceps, and the underlying bone of the promontory was entirely normal when we viewed it with the Zeiss ear microscope at 16 magnifications.

There was no evidence of any extension or communication of the lesion with the jugular bulb region.

The pathologist reported that the lesion was consistent with glomus tumor (Fig. 4).

Silver stains showed the typical reticula of nonchromaffin paragangliomas.

We made no attempt to biopsy the jugular foramen lesion or to assess its size except to note that since the hypoglossal nerve was also involved the lesion was probably relatively large.

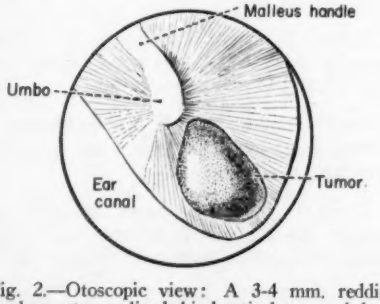


Fig. 2.—Otoscopic view: A 3-4 mm. reddish-blue glomus tumor lies behind entirely normal drum. Drawing from endoscopic photograph.

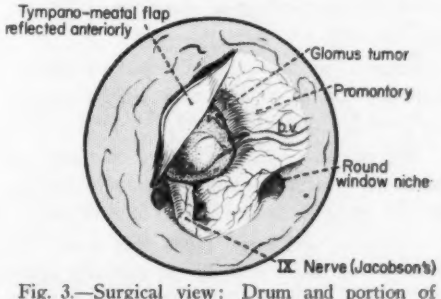


Fig. 3.—Surgical view: Drum and portion of postcanal wall lie forward. The tumor lies on the promontory. Jacobson's nerve proceeds into lesion. A small blood vessel passes posteriorly. Drawing from endoscopic photograph.

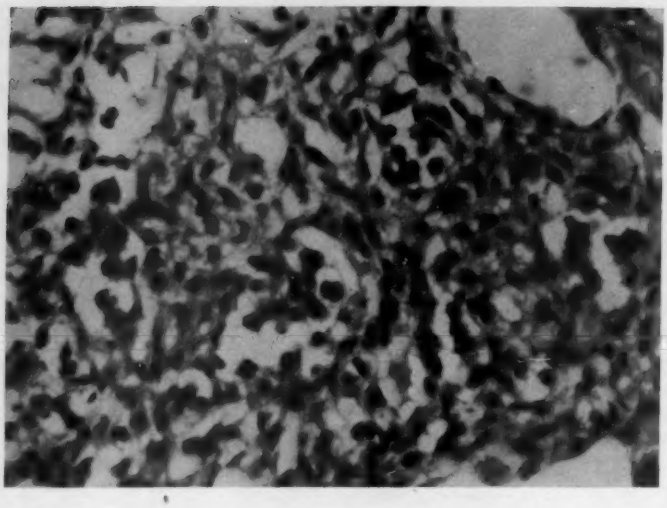

Fig. 4.—Histopathology of ear lesion. A nest of "chief" cells lies in the center of the field.

## Comment

We feel safe in assuming that the jugular foramen lesion is a nonchromaffin type because other authors [7,10,11] report it involved frequently in extensive temporal bone lesions of this type.

Further, we feel that, on the basis of the work of Guild, the middle ear lesion is a separate tumor and not what we ordinarily consider a metastasis, since it is separate from the deeper lesion and since there is no lymph node in this area to collect malignant cells.

## Summary

Nonchromaffin paragangliomas arise from carotid body-like tissue situated in the carotid and aortic bodies, the temporal bone, and the eye.

Several authors have reported simultaneous tumors of this type in the carotid body and temporal bone.[5-7]

We present a case with evidence of separate, concomitant nonchromaffin tumors in the jugular foramen and middle ear.

There is evidence from this case and others that there may be an exciting agent which causes nests of normally placed nonchromaffin paraganglial tissue to form tumors.

We suggest that large tumors of this type in the temporal bone may, in some cases, begin as separate lesions in two or more glomera jugulare and coalesce before diagnosis.

6900 W. Belmont Ave. (34).

## REFERENCES

1. Le Compte, P. M.: Tumors of the Carotid Body and Related Structures (Chemoreceptor System), Section IV, Fascicle 16, Atlas of Tumor Pathology, U. S. Armed Forces Institute of Pathology, 1951.

2. Guild, S. R.: Hitherto Unrecognized Structure, the Glomus Jugularis, in Man, Anat. Rec. (Supp. 2) 79:29 (March) 1941.

3. Rosenwasser, H.: Carotid Body Tumor of the Middle Ear and Mastoid, Arch. Otolaryng. 41:64-67 (Jan.) 1945.

4. Lattes, R., and Waltner, J. G.: Non-Chromaffin Paragangliomas of the Middle Ear, Cancer 2:447-468 (May) 1949.

5. Conley, J. J.: Multiple Paragangliomas in the Head and Neck, Ann. Otol. Rhin. & Laryng. 65:356-360 (June) 1956.

6. Kipkie, G. F.: Simultaneous Chromaffin Tumors of the Carotid Body and the Glomus Jugularis, Arch. Path. 44:113-118 (Aug.) 1947.

7. Lederer, F. L.; Skolnik, E. M.; Soboroff, B. J., and Fornatto, E. J.: Nonchromaffin Para-

ganglioma of the Head and Neck, Ann. Otol. Rhin. & Laryng. 67:305-331 (June) 1958.

8. Winship, T.; Klopp, C. T., and Jenkins, W. H.: Glomus-Jugularis Tumors, Cancer 1:441-448 (Sept.) 1948.

9. Guild, S. R.: Glomus Jugulare, a Nonchromaffin Paraganglion, in Man, Ann. Otol. Rhin. & Laryng. 62:1045-1071 (Dec.) 1953.

10. Crue, B. L.; Freshwater, D. B.; Shelden, C. H.; Hunnicutt, L. G., and Johnson, F.: Syndrome of the Jugular Foramen: A Syndrome Resulting from Neoplasms of the Posterior Fossa, A. M. A. Arch. Otolaryng. 63:384-391 (April) 1956.

11. Williams, H. L.; Childs, D. S., Jr.; Parkhill, E. M., and Pugh, D. G.: Chemodectomas of the Glomus Jugulare (Nonchromaffin Paragangliomas) with Especial Reference to Their Response to Roentgen Therapy, Ann. Otol. Rhin. & Laryng. 64:546-566 (June) 1955.

12. Rosen, S.: Glomus Jugulare Tumor of the Middle Ear with Normal Drum: Improved Biopsy Technique, Ann. Otol. Rhin. & Laryng. 61:448-451 (June) 1952.

# Esophagitis Edematosa Circumscripta Chronica

*Histological Investigation*

**SHOJI NIHO, M.D., and KAZUHIDE YASUDA, M.D., Yokohama, Japan**

In 1951, a lesion which should be referred to as esophagitis edematosa circumscripta chronica was reported by us.[1] The chief complaint of patients with this lesion is foreign-body sensation at the upper part of the esophagus. Although there are many diseases which produce a similar sensation, this lesion may be considered as the predominant cause of it.

During the past 10 years, we have been carrying out a histopathological study of specimens removed endoscopically in cases with this lesion, and findings observed in 91 cases are as follows:

| | | | |
|---|---|---|---|
| 1. | Sex | Male | 37 |
| | | Female | 54 |
| 2. | Age | 0-20 | 2 |
| | | 21-30 | 10 |
| | | 31-40 | 22 |
| | | 41-50 | 23 |
| | | 51-60 | 21 |
| | | 61- | 10 |
| | | Uncertain | 3 |
| 3. | Epithelium | Hypertrophy or thickness | 54 |
| | | No change | 36 |
| | | Atrophy | 1 |
| 4. | Edema in the submucous layer | | 34+++ |
| | | | 32++ |
| | | | 19+ |
| | | | 6— |
| 5. | Dilatation of capillaries in the submucous layer | | 27+++ |
| | | | 33++ |
| | | | 25+ |
| | | | 6— |
| 6. | Congestion of capillaries | | 22+++ |
| | | | 20++ |
| | | | 20+ |
| | | | 29— |
| 7. | Hemorrhage in the submucous layer | | 2+++ |
| | | | 3++ |
| | | | 8+ |
| | | | 78— |
| 8. | Cell infiltration in the submucous layer | | 2+++ |
| | | | 12++ |
| | | | 63+ |
| | | | 14— |
| 9. | Other changes in the submucous layer | | |
| | | Fibrosis | 42 |
| | | Stasis in the capillaries | 15 |
| | | Organization | 8 |
| | | Varix-like change | 2 |
| | | Fibrinoid swelling of capillaries | 1 |
| 10. | Edema in the tunica muscularis mucosae | | 15+++ |
| | | | 11++ |
| | | | 26+ |
| | | | 39— |
| | Degeneration of the muscular tissue | | 3 |
| 11. | Dilatation of glandular ducts or proliferation of the glandular tissue | | 6+++ |
| | | | 5++ |
| | | | 11+ |
| | | | 69— |

Esophagoscopically in this lesion, edema, swelling, and sometimes redness of the mucous membrane are observed at 17 to 22 cm. from the upper incisor teeth. Specimens for biopsy were taken for histological examination.

The initial sign of histopathological change observed is congestion of capillaries in the submucous layer of the esophagus. Then, as a result of increased permeability of the capillaries, serous transudate, sometimes red cells (hemorrhage by diapedesis), and cell infiltration around the capillaries are seen. Moreover, the loose submucous layer becomes diffusely edematous.

In cases where the above-mentioned changes have been persistingly present, the epithelial layer is hypertrophied or thick-

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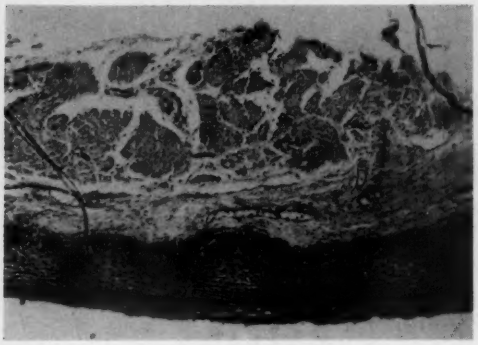

Fig. 1.—Normal esophagus. Changes appear in the submucous layer.

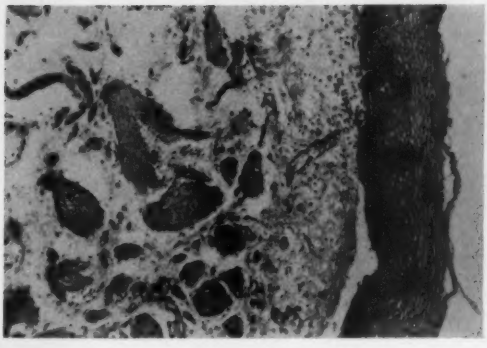

Fig. 2.—Cell infiltration in the propria. Edema; appearance of fibrin; edema in the muscularis mucosae.

Fig. 3.—Edema. Cell infiltration; hemorrhagia per diapedesin, dilatation of ducts.

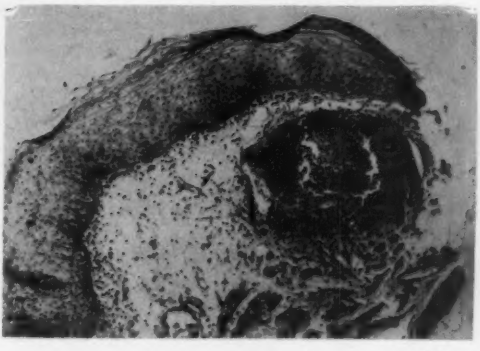

Fig. 4.—Cell infiltration; dilatation of lymph vesseis; edema; appearance of fibrin; lymph follicle.

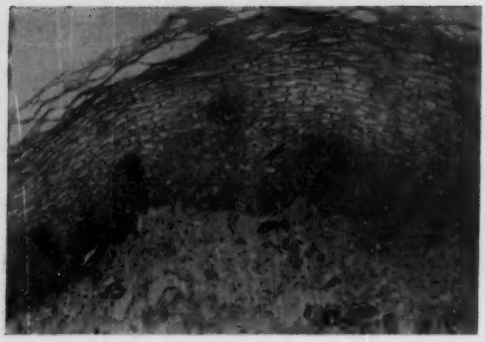

Fig. 5.—Thickness of epithelium; cell infiltration; dilatation of capillaries; congestion; edema.

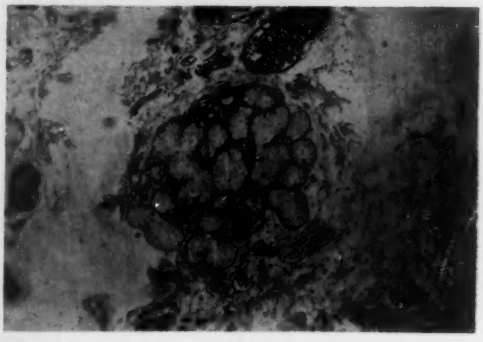

Fig. 6.—Proliferation of glandular tissue; edema; appearance of fibrin.

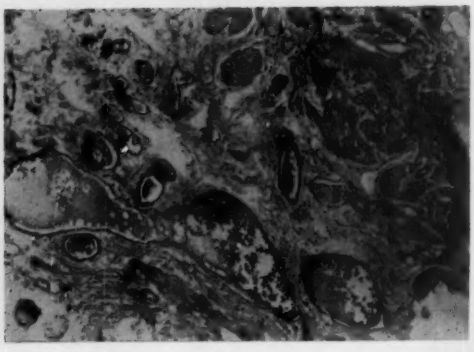

Fig. 7.—Edema in the muscularis mucosae; appearance of fibrin; congestion, stasis.

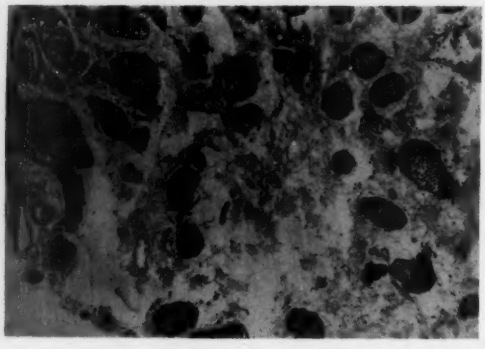

Fig. 8.—Edema in the muscularis mucosae, apearance of fibrin.

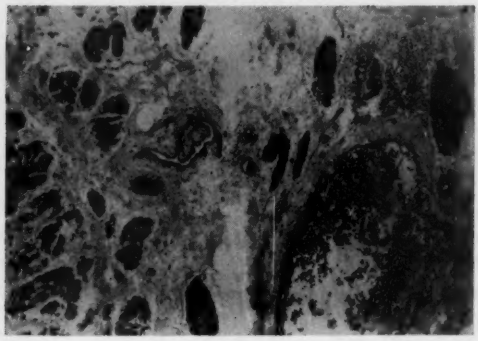

Fig. 9.—Dilatation of blood vessels; congestion, edema, hemorrhage.

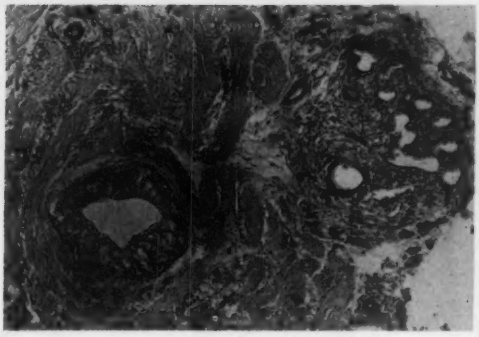

Fig. 10.—Dilatation of ducts; organization.

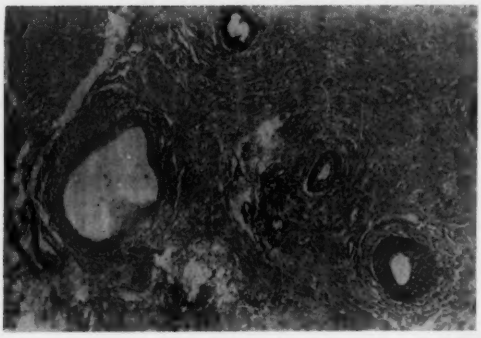

Fig. 11.—Dilatation of ducts; organization.

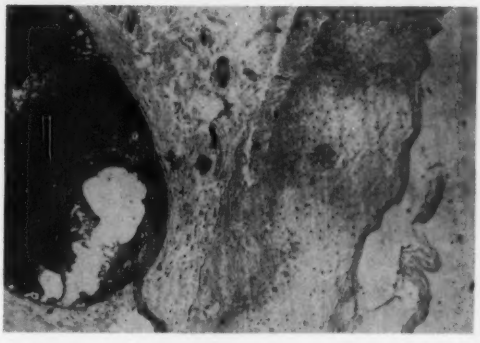

Fig. 12.—Proliferation of epithelium; congestion; hemorrhage; organization.

ened, and edema developes in the tunica muscularis mucosae. Capillaries are moderately dilated, showing stasis at times, and, although infrequently, even varix-like figurations. In some cases there are hemorrhage and organization of blood in the submucous layer. When edema in the submucous layer is marked and present continuously for a long time, fibrin appears in the edematous region. In some special cases, proliferation of glandular tissue and dilatation of ducts are found.

It is apparent, however, that subjective symptoms produced by this lesion arise from two sources, i. e., the above-recorded organic histopathological changes and emotional elements.

The chief complaints of patients with this lesion are foreign-body sensation in the throat, esophagus, or neck, stiffness of shoulder, feeling of obstruction in the throat or esophagus, oppressive feeling in the chest, and expectoration of blood, etc.

When these subjective symptoms persist for a long period, patients will tend to worry about the presence of Ascaris in the esophageal lumen, laryngeal tuberculosis, or cancer of the larynx or esophagus. Especially when these patients meet or hear of persons suffering from cancer of the larynx or esophagus they will become terror-stricken. On the other hand, in the majority of those patients who exhibit strong emotional disturbances traits of neurotic, hysteric, or schizophrenic tendency are observed.

**Summary**

A statistical investigation of esophagitis circumscripta edematosa chronica in 91 patients is presented.

As an initial sign of this lesion, congestion or hyperemia of capillaries in the submucous layer of the esophagus is histologically observed. Following increased permeability of capillaries serous transudate appears, and then edema, hemorrhage by diapedesis, or rhexis and cell infiltration take place.

In the second stage fibrin appears in the edematous region, and sometimes organization process, varix-like formation, or changes of glandular ducts are demonstrated.

Not only these histopathological changes but also the characteristic tendency of patients to worry about cancer, tuberculosis, or Ascaris in the laryngoesophageal region are of importance in the concept of this lesion, as those people with extreme traits of neurosis are liable to manifest severe subjective symptoms.

2 Dai-Machi, Kanagawaku.

**REFERENCES**

1. Niho, S.; Yoshio, K., Inaba, S.: J. Jap. Broncho-Esoph. Soc. 2:6, 1951.
2. Yoshio, K.: Otolaryngology, Tokyo 22:215, 1950.
3. Inaba, S.: Otolaryngology, Tokyo 22:309, 1950.
4. Takahata, N.: Yokohama M. J. 3:1, 1952.
5. Niho, S.: Iwatake, T., and Takahata, N.: J. Jap. Broncho-Esoph. Soc. 5:18, 1954.

## Audiology Section

JOSEPH SATALOFF, ASSOCIATE EDITOR

# A Check on Oto-Chek

CHARLES LIGHTFOOT, Ph.D.; RICHARD A. BUCKINGHAM, M.D., and MARY NEVILLE KELLY, M.Ed., Chicago

### Introduction

During the 1956 meeting of the American Academy of Ophthalmology and Otolaryngology, in the session on new instruments, Dr. Howard House presented the Oto-Chek, which he described as "a compact, battery-powered, transistorized, screening audiometer . . . [of which] there are two basic models. . . . One is a single-frequency model designed to test hearing at 4000 cycles, with fixed output levels of 20, 35 and 50 decibels. . . . The other is a double-frequency model designed to test hearing at 2000 cycles and at 4000 cycles with fixed output levels of 15 and 35 decibels. . . ." [1]

In January, 1957, Dr. House and Dr. Aram Glorig collaborated in reiterating the merits of Oto-Chek audiometry at the meeting of the Western Section of the American Laryngological, Rhinological and Otological Society, in San Francisco. The paper they presented there was published the following July in *The Laryngoscope* [2] shortly after the appearance of Dr. House's first paper, in the *Transactions of the Academy of Ophthalmology and Otolaryngology*.[1] In August, 1957, another, more detailed endorsement by Drs. House and Glorig appeared in this journal.[3] More recently, in *The Journal of the American Medical Association*,[4] they again presented their arguments and supporting material in favor of Oto-Chek screening.

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From the Department of Otolaryngology, University of Illinois College of Medicine (Drs. Lightfoot and Buckingham), and the Hearing and Vision Conservation Program, Chicago Board of Education (Mrs. Kelly).

In each of the papers cited above, Drs. House and Glorig described two methods of audiometric screening—one for each model of Oto-Chek. One method, with use of the single-frequency model, was recommended for industrial and military screening programs. The method consists in presenting to the subject's ear a 4,000 cps tone at one or both of the two higher levels allowed by the instrument and then at the 20 db. level. If the latter level elicits a response, the ear is classified as normal and is not tested further. If the 20 db. tone is not heard, the ear is considered to require further testing by means of standard audiometry.

The second audiometric method described by Drs. House and Glorig was recommended by them for school screening programs and for the examining routine of physicians. This procedure, for which the two-frequency model of Oto-Chek was designed, somewhat resembles the one described above in that it starts out by presenting to the subject's ear a 4,000 cps tone at 35 db. and then at 15 db. Ability to hear the lower-level signal, as in the other procedure, results in classifying the ear as a "negative"—that is, as one without impairment and beyond need of further testing. In contrast to the single-frequency test interpretation, however, failure to hear the lower-level 4,000 cps tone is not considered failure of the test. Rather, it is assumed that the ear may have an "insignificant 'dip' at 4,000." The ear is then presented with a 2,000 cps tone—first at 35 db., then at 15 db. Only if there is failure

to respond to 15 db. signals at both 4,000 and 2,000 cps is the ear classified as a "positive"—that is, as one requiring further testing. In order to distinguish it from the single-frequency test, we shall refer to the dual-frequency procedure as the House-Glorig test or, for the sake of brevity, the H-G test.

As evidence of the validity of Oto-Chek audiometry Drs. House and Glorig summarized the results of two screenings of 1,500 Los Angeles school children—once by a single-frequency test (4,000 cps at 15 db.) and once by a five-frequency sweep-check test at 15 db. The number passing the latter (93.9% of the total) was 99.5% as large as the number passing the Oto-Chek standard (94.4% of the total). "This indicates," said Dr. House, "that the single-frequency Oto-Chek screening method was 99.5 per cent as accurate as the standard sweep-check method. . . ."[1] No mention was made, for either test, of the number of children with ear pathology among those passing and those failing. Moreover, the single-frequency test which was compared with the sweep-check is not the H-G test, which was the one recommended for school use. Indeed, none of the papers by its originators offers evidence to support the claimed validity of the dual-frequency procedure.

Because of the fine reputation enjoyed—and, in our opinion, deserved—by Drs. House and Glorig, the fact that they saw in Oto-Cheking a screening technique of such merit as to evoke their repeated endorsement aroused our interest in it. Of especial interest to us, since it was recommended for school programs, was that particular type of Oto-Cheking procedure which we have called the H-G test. We were hopeful that we might find grounds for regarding that test as a valid one for use in the Chicago schools. We considered our best measure of the validity of the test to be the accuracy with which it locates impaired ears of the sort that is the concern of the Chicago program. With this point of view, we investigated the validity of the H-G test, using as subjects a group of Chicago school children who were suspected of having auditory impairment. It is the purpose of the remainder of this paper to present the manner and findings of our undertaking and to submit a few remarks based upon those findings.

## Procedure

Our first step was to review the records of the 600-odd children who, at the instigation of the hearing conservation program of the Chicago public schools, were scheduled for otological examination during the calendar year of 1957. The criterion for scheduling such an examination was a hearing loss, as revealed by conventional audiometry, of 30 db. or more at two or more frequencies in one or both ears. The examination was completed for 597 of the children. Our study was confined to the examination findings recorded for the 1,194 ears of those children.

The examination included history-taking, otoscopy, tuning-fork tests, and standard AC audiometry. Except for the latter the examining was done, under the direction of one of us (R. A. B.), by third-year residents of the University of Illinois Department of Otolaryngology. The audiograms were obtained by experienced school audiometrists, under reasonably quiet conditions. In nearly all cases, the audiometry was done immediately prior to the other parts of the examination. None of the examiners had any knowledge of our interest in the H-G concept of screening. Indeed, all of the examinations were completed and the findings recorded before we conceived of this investigation.

In order to learn which ears could pass one or both types of Oto-Chek, we categorized the audiograms as follows: (1) those showing a loss at 4,000 cps of 15 db. or less, (2) those showing a loss at 4,000 cps of 20 db. and a loss at 2,000 cps of 15 db. or less, (3) those showing a loss at 4,000 cps of 25 db. or more and a loss at 2,000 cps of 15 db. or less, (4) those showing a loss at 4,000 cps of 20 db. and a loss at 2,000 cps of 20 db. or more, and (5) all audiograms not falling in the categories above.

Since we were primarily interested in the H-G test, we thereafter directed our attention to the ears represented by the first three categories listed above, i. e., those which could respond to a 15 db. tone of either 2,000 or 4,000 cps. For such ears, we determined, from the otological examiners' reports, which ones were apparently normal and which ones provided positive otoscopic findings or other signs of defect.

## Results

The fivefold audiogram categorization described in the preceding section resulted

TABLE 1.—*Distribution of 1,194 Ears Among Five Mutually Exclusive Audiometric Categories*

| Category | Hearing Loss, Db. At 2,000 | Hearing Loss, Db. At 4,000 | Ears No. | Ears % |
|---|---|---|---|---|
| 1 | Immaterial | ≤15 | 405 | 33.9 *† |
| 2 | ≤15 | 20 | 57 | 4.8 *† |
| 3 | ≤15 | >20 | 90 | 7.5 * |
| 4 | >15 | 20 | 65 | 5.4 † |
| 5 | >15 | >20 | 577 | 48.3 |
| Total | | | 1,194 | 100.0 |

* Could pass the H-G test.
† Could pass single-frequency 20 db. Oto-Chek.

in the data summarized in Table 1. About 48% (the 577 in Category 5 of Table 1) of the 1,194 audiograms showed losses greater than 20 db. at 4,000 cps and greater than 15 db. at 2,000 cps and thus indicated that the ears they represented would not be passed by Oto-Chek screening whether the double-frequency 15 db. instrument or the single-frequency 20 db. instrument was used. An additional 7.5% (90) of the ears (Category 3), although capable of hearing a 2,000 cps tone at the 15 db. level, also had losses greater than 20 db. at 4,000 cps and thus would have been failed by the single-frequency instrument. Such an instrument, in other words, would have passed 527, or 44%, of the ears (Table 1, Categories 1, 2, and 4) and would have failed 667, or 56% (Categories 3 and 5). In addition to those ears which would have been failed by either type of Oto-Chek, a few more than 5% (the 65 in Category 4), although capable of responding to the test signal of the single-frequency Oto-Chek, would have been failed by the H-G test. Thus, the latter would have passed 552, or 46%, of the ears (Categories 1, 2, and 3) and would have failed the remaining 642 (Categories 4 and 5).

The otological examiners' reports showed that, of the 552 ears capable of passing the H-G test, positive otoscopic findings were recorded for 49.3%, or 272 ears. An additional 109 of the passing ears, although having normal-appearing drums, showed by their audiometric responses that they had substantial perceptive impairment. In all, 381 ears, or 69% of all which could pass the H-G test, were false negatives—that is, they were defective and, by our standards, were in need of otological management.

Among the impaired ears contributing to the high yield of false negatives of the H-G test were 146 cases of secretory otitis media. About three out of every five of these could pass the H-G test because of their ability to hear at 4,000 cps. Audiometric data for this group are summarized in the upper part of Figure 1. As might be expected, median losses for this group were mild—15 db. at the lower three frequencies and at 8,000 cps and 10 db. at 2,000 and 4,000

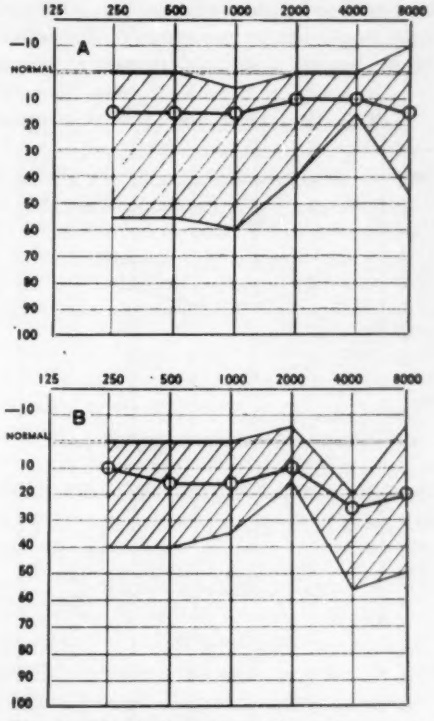


Fig. 1.—Threshold medians (shown by circles) and ranges (shown by heights of hatched area) for two groups of ears, all of which had secretory otitis media and yet could pass the H-G test. *A* (top), group of 90 diseased ears which could hear a 15 db. 4,000 cps tone and thus could pass the H-G test. *B*, group of 56 diseased ears which could not hear a 15 db. 4,000 cps tone but could hear a 15 db. 2,000 cps tone and thus could pass the H-G test.

cps. However, as shown by the extent of the hatched area on the chart, in which would fall all of the audiograms recorded for the group, there were many cases of more extreme loss. A second group of ears with secretory otitis media, including 56 cases, are represented in the lower portion of Figure 1. According to the House-Glorig system, these ears would be presumed to be normal, except for "insignificant 'dips' at 4,000 cycles."

The external canals of 70 of the ears which could pass the H-G test were blocked by enough cerumen to indicate referral to a physician for its removal. In the majority of these cases, represented in Figure 2*A*, the initial test signal of the H-G test could be heard and presentation of the 2,000 cps tone would not be required. A flat audiogram showing a loss of less than 15 db. at most frequencies was typical of this group. A number of ears, however, had low-frequency losses greater than 30 db. In some of these, of course, the bulk of the loss may have been due to some middle ear impairment rather than to cerumenal impaction. Sixteen of the cerumen-blocked ears, represented in Figure 2*B*, although unable to hear a 2,000 cps tone at 15 db., could pass the H-G test at 2,000 cps. The median losses of these were somewhat larger than were those of the blocked ears mentioned above. Not one of these ears could hear a signal below 5 db. at any frequency.

Among the 69% yield of false negatives on the H-G test were 56 ears with chronic otitis media, including a number actively discharging. Figure 3*A* summarizes audiometric data obtained for a group of 33 of these ears which could hear sufficiently at

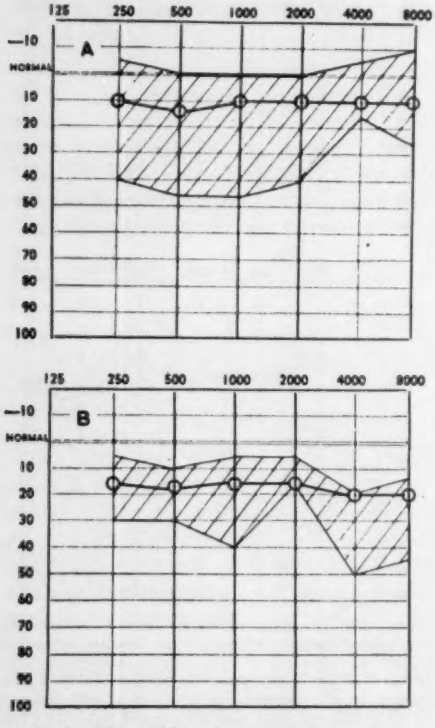


Fig. 2.—Threshold medians and ranges for two groups of ears, all of which were blocked by cerumen and yet could pass the H-G test. *A*, group of 54 blocked ears. *B*, group of 16 blocked ears.

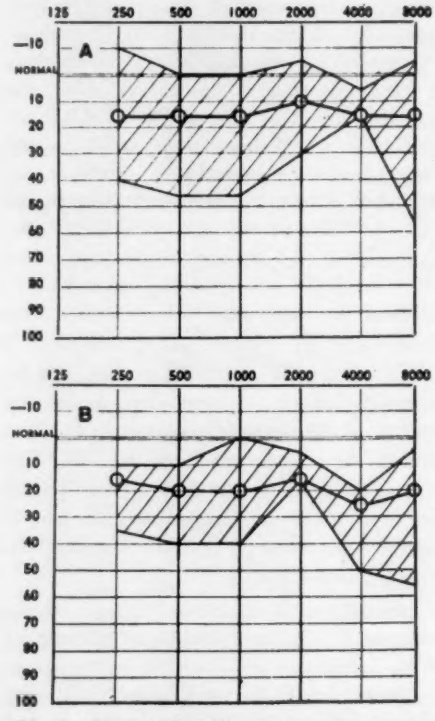


Fig. 3.—Threshold medians and ranges for two groups of ears, all of which had chronic otitis media and yet could pass the H-G test. *A*, group of 33 defective ears. *B*, group of 23 defective ears.

4,000 cps to pass the H-G test. The median hearing loss for this group at five of the six tested frequencies was 15 db.; at 2,000 cps the median was 10 db. As was true for the groups with secretory otitis and meatal blockage, there were a number of ears with low-frequency losses of 30 db. or more, even though no ear had a loss greater than 15 db. at 4,000 cps. Audiometric data for 23 ears which could pass the H-G test at 2,000 cps despite the presence of chronic otitis media are summarized by Figure 3*B*. The median losses for this group, compared to the other false negatives with the same diagnosis, were somewhat greater, ranging from 15 to 25 db.

The ears which could pass the H-G test despite the presence of substantial perceptive loss furnished the audiometric data displayed by Figure 4. The diagnostic classification of perceptive impairment was used when the Rinne test was positive and the drum appeared to be normal. The degree of impairment was considered substantial when the audiogram dropped as low as 30 db. at one or more frequencies and/or when it fell to the 20 db. level at two or more frequencies and/or when the arithmetic mean of the losses at all six frequencies was 12.5 db. or greater. For the 60 of these ears which could respond to the H-G test signal at 4,000 cps, the median loss was 15 db. at every frequency. As with the various groups of conductively impaired ears passing the H-G test, there were a number of ears in this perceptively impaired group showing losses of 30 or 40 db. at low frequencies despite the much milder degree of loss at 4,000 cps. It is possible, of course, that some of these ears also had some undetected conductive impairment. A second group of perceptively impaired ears could pass the H-G test only at 2,000 cps. The median loss found for the 49 in this group at the frequencies of 2,000 cps and below was 15 db.; the median at 4,000 cps was 25 db.; at 8,000 cps it was 20 db.

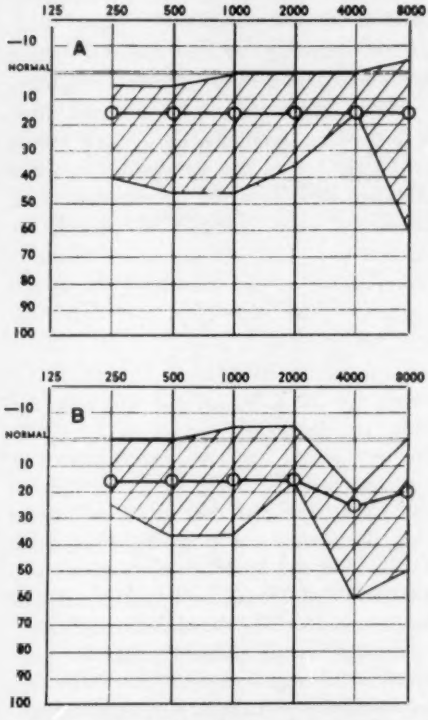


Fig. 4.—Threshold medians and ranges for two groups of ears, all of which showed signs of substantial perceptive impairment and yet could pass the H-G test. *A*, group of 60 impaired ears. *B*, group of 49 impaired ears.

Although our study was not primarily designed to suggest ways of improving on the H-G test or to compare it with other screening tests, the data in Table 2 are provided for the reader who might be interested in making certain comparisons. The first row of tabulated figures simply reiterates the number of ears in each diagnostic category, the total number of impaired ears and the number of normal ears which would be passed by the H-G procedure. The second row of figures also includes previously presented data but in a way to emphasize that the numbers of false negatives listed in the first row could be reduced considerably by rejecting the point of view of Drs. House and Glorig concerning losses at 4,000 cps. Their belief is that unless such losses are accompanied by equal losses at 2,000 cps they can be interpreted as 4,000 cps dips which, "In school children

TABLE 2.—*Numbers Among 1,194 Ears in Various Diagnostic Categories Which Could Pass Fifteen Decibel Auditory Screening with Various Combinations of Test Frequencies Listed in Diminishing Order of False-Negative Yield*

| Row | Frequency Combination | Secr. O. M. | Cerum. Block. | Chron. O. M. | Perc. Imp. | Total Impaired | Normal |
|---|---|---|---|---|---|---|---|
| 1 | 4,000 or 2,000 | 146 | 70 | 56 | 109 | 381 | 171 |
| 2 | 4,000 only | 90 | 54 | 33 | 60 | 237 | 168 |
| 3 | 4,000 & 2,000 | 74 | 47 | 23 | 46 | 190 | 166 |
| 4 | 4,000 & 250 | 70 | 43 | 22 | 36 | 171 | 166 |
| 5 | 4,000 & 1,000 | 58 | 44 | 24 | 41 | 167 | 167 |
| 6 | 4,000 & 8,000 | 57 | 45 | 25 | 33 | 160 | 158 |
| 7 | 4,000 & 500 | 55 | 42 | 19 | 32 | 148 | 165 |
| 8 | 500 through 4,000 | 45 | 39 | 16 | 22 | 122 | 162 |
| 9 | 250 through 4,000 | 43 | 38 | 14 | 18 | 113 | 159 |
| 10 | 500 through 8,000 | 30 | 33 | 15 | 7 | 85 | 152 |
| 11 | 250 through 8,000 | 29 | 33 | 13 | 3 | 78 | 149 |

. . . , are usually due to a congenital defect that is relatively unimportant in itself." [4] Of the 147 ears in our sample which could not hear a 4,000 cps tone at 15 db. but could hear a 2,000 cps tone of that level (Categories 2 and 3 in Table 1), all but 3 were classified as defective, in most cases as a result of the otoscopic findings. Of the perceptive impairments in that group, very few, in our opinion, could be regarded as "due to a congenital defect that is relatively unimportant." Thus, it would appear that use of only the 4,000 cps channel of the two-frequency Oto-Chek would reduce the total yield of false negatives from 381 to 237, a reduction of nearly 38%, while adding only three false positives, i. e., normal ears failing to pass.

The third row in Table 2 shows what would happen if the criterion of passing was ability to hear at the 15 db. level at both 4,000 *and* 2,000 cps rather than at either 4,000 or 2,000 cps as recommended by Drs. House and Glorig. Adoption of this double-frequency criterion would result in a diminution of the number of false negatives to 190, which is only half of the yield of the H-G procedure. Moreover, as is shown by the difference between the number of normal ears passing this double-frequency test (166) and the number of normal ears passing the H-G test (171), there would result only 5 false positives among the 1,194 ears. Lending interest to this finding are the following statements of Dr. House concerning the Los Angeles school children mentioned above: "Five hundred of these children were then screened by the Oto-Chek method at both 2,000 and 4,000 cycles to determine whether a greater accuracy would result when two frequencies were used. No noticeable increase in accuracy resulted." [1]

After learning of the benefits which could be had by the user of a two-frequency Oto-Chek instrument if he departed from the procedure recommended by Drs. House and Glorig for its use, we decided to see if additional benefits might be obtained if the instrument were modified to provide, in addition to a 4,000 cps signal of 15 db., a second signal of the same level but with a frequency other than 2,000 cps. Our findings, summarized in Rows 4-7 of Table 2, indicate that substitution of any other frequency for the 2,000 cps one which the existing two-frequency model of Oto-Chek provides would be an improvement. A screening test requiring ability to hear at both 4,000 and 250 cps at 15 db. would bring the number of false negatives down to 171. Requiring ability to hear at both 4,000 and 1,000 would shave four off that number. A combination of 4,000 and 8,000, interestingly enough, would reduce the number of false negatives even more—to 160. We found the best single frequency to combine with 4,000 cps to be 500 cps. Such a combination reduced the number of false negatives to 148, which is a 61% reduction

from the H-G yield and a 22% reduction from the lowest number which could be achieved by optimal use of the existing two-frequency Oto-Chek audiometer. Regardless of which lower frequency might be used in combination with 4,000 cps, there would be no more than a half dozen false positives among the 1,194 ears in our sample. The 4,000-8,000 combination, however, would fail 13 of the normal ears in that group.

Because Drs. House and Glorig have compared certain results of their method with those of sweep-check audiometry, we decided to see how the impaired ears in our sample which could pass the H-G test would fare with various 15 db. sweep-check tests. The results are summarized in the four lower rows of Table 2. Sweep-checking only four frequencies, from 500 through 4,000 cps, and requiring response at each one would effect more than a two-thirds reduction in the H-G yield of false negatives while raising the number of false positives to only nine (or 171 − 162). Extending the frequency range of the sweep downward through 250 cps and requiring response at each of the five test frequencies so included would eliminate nine more false negatives while creating only three additional false positives. If the sweep-check included all six test frequencies, from 250 through 8,000, the total number of false negatives would drop to 78 while the number of false positives would total only 22. Such a test, in other words, while it would focus suspicion on a relatively small number of healthy ears, would catch 303 impaired ears which the H-G test would erroneously pass as normal.

It may interest the reader to notice that, while reducing by 80% the total H-G yield of false negatives, the six-frequency sweep check would not effect the same degree of reduction in all categories of ear impairment. Those with secretory otitis media constituted the largest group of defective ears misclassified by the H-G test. In contrast, the largest group among the 78 false negatives of the sweep check were the ears blocked by cerumen. To the extent that the condition of the latter may be viewed as less seriously in need of attention than secretory otitis it may be argued that these qualitatively different results of the sweep procedure should be counted as an additional point in favor of that method.

No mention has yet been made of the type of sweep check Dr. House had reference to in his earlier quoted statement, "The single-frequency Oto-Chek screening method was 99.5 per cent as accurate as the standard sweep-check method." [1] It will be recalled that this statement developed from the observation that 93.3% of 1,500 Los Angeles children could hear the five test tones from 500 through 8,000 cps at 15 db. and that 94.4% of the same children could hear a 4,000 cps tone of the same level. The percentage figure of 99.5 in Dr. House's statement is the quotient obtained when 93.3 is divided by 94.4. A comparable quotient can be derived from the data in Table 2. Row 10 of the Table shows that 237 ears (152 normal and 85 impaired) could hear a 15 db. tone at each of the five test frequencies from 500 through 8,000 cps. This number amounts to 19.8% of the 1,194 ears in our sample. Row 2 of the Table shows that 405 ears (168 normal and 237 impaired) could hear a 15 db. 4,000 cps tone. This number is 33.9% of the total. Dividing 19.8 by 33.9, we learn that, if applied to our Chicago sample, the single-frequency 15 db. Oto-Chek method would presumably be considered by Dr. House (and also by Dr. Glorig, for he has affirmed Dr. House's computational procedure [4]) as 58.4% as accurate as the type of sweep-check audiometry they designate as standard.

In comparing the "accuracy" of sweep-check audiometry with single-frequency screening, Drs. House and Glorig have done so while under the impression that the latter method, when applied to school children, is less accurate than the two-frequency method which we have been referring to as the H-G

test. As has been pointed out, such an impression would not be valid for our Chicago children. We thought it interesting, therefore, to apply the House-Glorig computation of relative "accuracy" to the results we obtained for the H-G test. Dividing the number of ears in our sample which could pass that test into the number which could pass the five-frequency combination, to which Row 10 of Table 2 pertains, we learned that Drs. House and Glorig would consider the Chicago performance of their test 42.9% as "accurate" as the performance of the type of sweep check used in Los Angeles.

In applying the House-Glorig computation of "accuracy" to our data, we wish to emphasize that we do so only for comparative purposes. We do not intend to leave the impression that we endorse either the computational procedure or the assumptions inherent in it. A more widely used and, to us, more acceptable approach to the comparison of two tests with respect to validity is to relate their yields of false negatives. Such an approach would allow us to say, since the number of false negatives in Row 1 of Table 2 exceeds the 85 in Row 10 by 303, that the H-G test was 348% more inaccurate than the five-frequency sweep check.

## Comment

The results we have reported leave us with a feeling of disappointment in the H-G test as a possible screening procedure for use in the Chicago public schools. Use of the test, we believe, would result in our missing a large proportion of children with one or both ears impaired. In stating this conclusion we do not mean to suggest that the incidence of false negatives in terms of children would be as high as the incidence reported in the preceding section in terms of ears. Because of the nature of our sample, there were a number of cases in which an ear reported as a H-G false negative belonged to a child whose contralateral ear was even more defective. In many of these cases the child would have been identified by the performance of his poorer ear on the H-G test. In a large, unselected sample of children, however, an ear contralateral to one erroneously passed by the H-G test could have a 4,000 cps (or 2,000 cps) loss greater than that of the passed ear or it could have the same degree of loss or it could have less loss. It seems to us that the odds favor the occurrence of either one or the other of the latter two possibilities. It is our opinion that if finding children in the Chicago schools with an ear impairment depended solely upon use of the House-Glorig test more than half of such children would go undetected.

It is unfortunate that, in comparing the two tests which were administered to the 1,500 Los Angeles school children, Drs. House and Glorig allowed themselves to dwell on the numbers passing to the exclusion of considering the numbers failing. Children with impaired ears, fortunately, constitute a very small fraction of the total number in any school system. The inevitable consequence of this fact is that almost any conceivable auditory screening test will pass 90-odd % of the children tested. Dividing the percentage passing one test by the percentage passing another test will inevitably yield a quotient close to one. To offer such a quotient, as did Drs. House of Glorig, as an indication of the accuracy of one test relative to the other is likely to be misleading.

More important than the fact that 93.3% of the Los Angeles children passed the sweep-check test is the concomitant fact that 6.7%, or 101 of the 1,500 children, failed that test. Similarly, the fact that 94.4% passed the single-frequency test is less important than the fact that only 5.6%, or 84 children, failed. Had Drs. House and Glorig considered the numbers failing, they would have realized that 17 (101−84) children, each of whom probably suffered from either a unilateral or bilateral ear defect, were missed by the single-frequency test. Had Drs. House and Glorig then made a

proper allowance for the fact that their dual-frequency test is considerably easier to pass than the single-frequency test, they might have realized that a quarter or more of the 101 children who failed the sweep check would pass the House-Glorig test. Had Drs. House and Glorig made additional allowance for the fact that even the sweep check is an imperfect test and, therefore, probably passed several children with ear defects, they might have come to the conclusion that the H-G test would probably miss 30% or 35% of the ear-defective children in the Los Angeles group. Awareness of such a proportion of false negatives, even though it is considerably below that which we estimate for the Chicago situation, would undoubtedly have prevented Drs. House and Glorig from recommending use of their test—even in the schools of the sunny area where the test was devised.

Although our primary concern has been with the H-G test as a school screening procedure, we believe our data are also pertinent to use of the test, as recommended by its originators, by physicians in office practice. Drs. House and Glorig have made the following statement:

> The limited frequency screening test provides a simple and accurate test for . . . the routine needs of the otolaryngologist, pediatrician, internist, and general practitioner. It is not necessary to make threshold audiograms to satisfy the needs of . . . these physicians; it is sufficient to determine only whether a patient has normal hearing.[4]

In the introductory section of this paper, we mentioned that Drs. House ond Glorig have recommended the double-frequency Oto-Chek for physicians' use. Actually, there is some confusion in our minds as to what instrumentation and procedure Drs. House and Glorig regard as best for various specialty groups. In his initial paper on the Oto-Chek, Dr. House gave us the impression that he was referring to the single-frequency instrument when he said, "This instrument . . . is ideally suited for . . . testing in doctors' offices (otolaryngologists and general practitioners). . . ."[1] In a later paper, Drs. House and Glorig specifically recommended the double-frequency Oto-Chek for use by pediatricians, internists, and general practitioners.[2] In the subsequent paragraph of the same paper, it is mentioned that some otolaryngologists, whose procedure evidently has the approval of Drs. House and Glorig, have a double-frequency Oto-Chek with which the nurse checks the patient's hearing. The remainder of the paragraph, however, reads as follows:

> If the patient hears 4000 c. p. s. at 15 db., it may be assumed that he or she has essentially normal hearing. If a patient fails to hear the test tone at a higher level, for example, 35 db., a complete threshold audiogram can then be recommended.[2]

We shall not argue against this last-quoted procedure, for we believe that it must have been the product of a clerical or printing error. We cannot believe that Drs. House and Glorig would intentionally recommend that otolaryngologists reserve threshold audiometry for only those patients who demonstrate a loss at 4,000 cps in excess of 35 db. In another paper, Drs. House and Glorig recommend single-frequency 15 db. audiometry for otolaryngologists, general practitioners, internists, and pediatricians.[3] In their most recent paper, however, Drs. House and Glorig recommend for the latter three categories of physicians a double-frequency test like the one we have called the H-G test, except that the recommended minimal signal level is 20 db. Thus, if the patient "fails to hear at both 4,000 and 2,000 cps at 20 db., he should be referred for threshold testing."[4] In making this last recommendation, Drs. House and Glorig did not comment on the fact that the double-frequency model of Oto-Chek does not provide a 20 db. signal level.

It matters little to us which of the above recommendations has the current favor of Drs. House and Glorig, for we oppose the adoption of any of them by any physician, regardless of his specialty. We particularly oppose the adoption of any of the House-Glorig procedures by any physician whose practice requires examination of children.

We are convinced that the 15 db. H-G test, if used by a physician in the examination of his juvenile patients, would result in his classifying as normal the hearing of a large proportion of the impaired ears. The proportion of such erroneous classifications would, of course, be considerably larger if the 20 db. double-frequency procedure were followed. If the physician is expert in otoscopic examination many of the impaired ears may be found even though their hearing has been described as normal. One wonders, however, how many pediatricians, internists, and general practitioners are skilled enough in the art to rely exclusively on their otoscopy. Even an experienced otologist, if given the mistaken notion that an ear hears normally, is likely to perform his examination of the ear with more haste than he would under less prejudicial circumstances. Drs. House and Glorig have argued that a quick, simple screening test is better than no hearing test. We do not accept this argument. A test which has a high rate of false negatives too frequently breeds a false feeling of security in both the physician and the parent of a child with one or both ears diseased.

It seems to us that when a physician examines an ear, he should be concerned not with whether or not the ear has "near-average" hearing but rather with whether or not that ear deviates in any way from its optimal state. Frequently he does not know what the optimal state of the ear might have been before the time of examination. If the patient is a child, however, the physician can feel confident that the optimal hearing level, regardless of frequency, was probably much better than 15 db. Indeed, the optimal hearing level was probably better than the audiometric zero level, for it is now generally recognized that the norms established in this country for young, healthy ears are too liberal.[5] The audiogram of an ear belonging to a typical healthy 12-year-old child is more likely to be near the −10 db. level than at 0. A condition such as secretory otitis media might reduce the 4,000 cps acuity of such an ear to the +10 db. level. There is a good chance, despite the contradictory assertions of Drs. House and Glorig, that the loss at frequencies below 1,000 cps might be greater by 5 or 10 db. Thus, the actual threshold shift produced by the disease might be 20 db. at 4,000 cps and 30 db. at 500 cps, with intermediate amounts of shift between those two frequencies. We hope we will be forgiven for having some doubts as to how a pediatrician or general practitioner who has come to rely on an Oto-Chek might categorize such an ear as we have described. We are afraid that, as often as not, the diagnosis would be "normal ear."

We are not categorically opposed to all limited-frequency audiometry. Indeed, we see definite advantages to its use in the circumstances for which it was developed. Limited-frequency screening, according to Drs. House and Glorig, "Was originally developed to determine the status of hearing of persons who work in noisy environments. . . ."[4] Although we have had little experience with industrial programs, we believe that such programs can benefit greatly from the House-Glorig contribution. We are particularly impressed by the possible application of the single-frequency procedure in the manner suggested in a recent paper by Dr. Glorig.[6] The suggestion was to utilize 4,000 cps screening in periodic postplacement checks on workers who, prior to employment, had been given a complete examination, including full-scale threshold testing.

Limited-frequency audiometry also can be used to advantage under certain circumstances by physicians. We refer here not to Oto-Chek screening but rather to threshold testing at two frequencies, such as 500 and 4,000 cps. Such procedure should be employed, however, only in cases where the physician has in his files an audiogram representing the patient's optimal hearing. If hearing at 500 and at 4,000 cps is within 5 db. of the previously recorded levels it can be assumed that the patient's hearing is

probably not undergoing impairment by disease.

## Summary

A study of Chicago school children showed that the Oto-Chek screening procedure advocated by House and Glorig for use in school programs and physicians' offices is inadequate. Its inadequacy lies in its tendency to pass as normal excessively large numbers of impaired ears. Of 552 ears capable of passing the H-G test, 381 (69%) were found by otological examination to be defective.

Speech and Hearing Center, Illinois Eye and Ear Infirmary, 904 W. Adams St. (7).

## REFERENCES

1. House, H. P.: A New Instrument and Concept for the Rapid Detection of a Possible Hearing Impairment, Tr. Am. Acad. Ophth. 61:228-230 (March-April) 1957.

2. House, H. P., and Glorig, A.: A New Concept of Auditory Screening, Laryngoscope 67:661-668 (July) 1957.

3. Glorig, A., and House, H. P.: A New Concept of Auditory Screening, A. M. A. Arch. Otolaryng. 66:228-232 (Aug.) 1957.

4. House, H. P., and Glorig, A.: New Practical Concept of Hearing Testing for Use by the General Practitioner, J. A. M. A. 166:1719-1721 (April 5) 1958.

5. Albrite, J. P., et al.: Research in Normal Threshold of Hearing, A. M. A. Arch. Otolaryng. 68:194-198 (Aug.) 1958.

6. Glorig, A.: Hearing Evaluation in Industry, Eye, Ear, Nose & Throat Month. 36:519-523 (Sept.) 1957.

# The Perceptual Process in Speechreading

JOHN B. BRANNON Jr., M.A., and FRANK KODMAN Jr., Ph.D., Lexington, Ky.

Patients with hearing impairments frequently appear before the otologist giving evidence of a well-developed skill of *lipreading*, or *speechreading*. Often, this skill is unconsciously developed to overcome the barrier to communication created by loss of hearing. Miriam Pauls [8] expressed this idea, "While facility is usually developed to a high degree only by formal instruction, necessity can produce spectacular skill." The degree to which such persons depend upon speechreading is directly related to the nature and amount of their hearing loss. In particular, the poorer the speech discrimination (PB) score, the more the person employs this skill. In other words, those with perceptive impairments are usually more dependent upon speech reading than those with conductive loss.

In spite of the widespread appearance of this skill, little is known about the perceptual process involved in it. The relevant variables would seem to be type of materials for speechreading and individual differences between subjects. To date, no significant individual difference variables have been found which are related to speechreading ability. Therefore, the ability to lipread has been erroneously referred to as an "art." For example, Utley [12] found that lipreading ability could not be predicted from reading level, school achievement, chronological age, age at onset of deafness, or grade placement. Such factors as intelligence, memory span, and language comprehension probably enter into the process, but no single factor has been found to be all important. Pintner [9] found practically zero correlations between lipreading ability and intelligence, with use of a nonlanguage intelligence test. But there is some doubt about the validity of using deaf children to determine this relationship, since the exact measurement of the intelligence of deaf children is not certain. Pintner himself was aware that the relationships reported were much lower than expected owing to restricted range of talent. Previous efforts tend to fall into two areas: those dealing with perceptual cues and those dealing with the development of a standardized test of lipreading ability. Gault,[3] Kitson,[5] and O'Neill [7] contributed to the area of perception. O'Neill's recent finding was that normal-hearing persons utilize vision extensively in speech perception, in discriminating differences between spoken vowels and consonants. Saltzman [10] reasoned that lipreading ability must be related to speed of cerebration. His notion is that the masterful speechreader is born with "an eye for tell-tale facial expressions and lip movements."

To date, no experiment has been conducted to compare directly the performance of persons who are highly skilled in speechreading with that of totally unskilled persons. O'Neill [7] had used a group of unskilled subjects in an experiment involving both audition and vision and found that they were able to lipread very readily when the stimuli were spoken vowels and consonants. The purpose of this experiment is to meet the need for a comparison between skilled and unskilled groups in lipreading the same materials, in an effort to

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Audiologist, Lexington Clinic (Mr. Brannon [M.A., University of Kentucky, 1957]); Assistant Professor of Psychology and Director of the Audiology Clinic, University of Kentucky. (Dr. Kodman [Ph.D., University of Illinois, 1954]).

isolate variables relative to the materials which contribute to their visual identification and to determine important differences between these two groups. To rule out contributions made by context as nearly as possible, a list of isolated words was selected for intensive analysis. The list under study was PB List No. 6, one of the Harvard PB-50 series of monosyllabic words, used by audiologists to test for the discrimination of speech sounds by hearing. These lists have not been previously used for this purpose.

## Experimental Variables

Four word characteristics were selected before the experiment for correlation with word intelligibility, or the percentage of times a word was correctly identified. These were visibility, vertical mouth opening, word frequency, and phonetic units. Visibility refers to the degree of visible movement associated with the production of the word by the lips, teeth, tongue, and facial areas. In order to obtain a visibility score for each word, each was rated along a nine-point scale after being viewed by 10 judges trained in speech and hearing. Average visibility ratings were computed for each word, and these values ranged from 1.7 to 7.9, with a mean of 5.6.

The vertical-mouth-opening variable was selected on the assumption that differences in the size of the mouth opening would contribute to the visual intelligibility of the test words. Measurements were made to the nearest millimeter by means of a microfilm viewer from the motion picture film described below. These measurements ranged from 9.0 to 34.2 mm., with a mean of 22.2.

The third variable, word frequency, relates to the familiarity of the words. A score was assigned to each word in PB List No. 6, based upon its frequency of occurrence as listed in the Thorndike word counts.[33] The range of assigned values was 1 to 22, with a mean of 14.5. Words with the highest frequency of usage were valued at 22.

Phonetic units, the fourth variable, refers to an arbitrary word length based upon the phonetic composition of the word, as defined by Kodman.[6] Each individual sound in a word was assigned a score of 1, with the exception of diphthongs and affricatives, which were given a score of 1.5. The values for phonetic word length ranged from 2 to 5.5, with a mean of 3.41 units.

## Experimental Procedure

*Subjects.*—The skilled group consisted of eight hard of hearing adults, one man and seven women, whose average age was 54.3 years and who were experienced in speechreading. The unskilled group was composed of eight normal-hearing adults, mean age 22.6 years, who had no previous experience in speechreading.

*Apparatus and Materials.*—The principal apparatus was a silent motion picture film, depicting a close-up view (face and neck) of a talker presenting the 50 words of PB List No. 6. This film was prepared with the assistance of the University of Kentucky Radio Arts Department. The talker spoke each word following a carrier phrase, "You will write. . . ." Blank film lasting 15 seconds was inserted between items, during which time the subjects recorded their responses. A 16 mm. Bell and Howell projector was used to throw the image upon an upright screen. Other materials included the Utley Sentence Test, Form A, consisting of 31 sentences (125 words) and mimeographed answer sheets for both the sentence and word tests. The subjects sat in chairs with arm rests.

*First Session.*—Both groups were administered the Utley Lip-Reading Sentence Test, Form A, in in a two-room, sound-treated laboratory. The talker sat in one room and was viewed by the subjects in an adjacent room through a 28×34 in. glass partition. No audible cue was available. A series of lights was projected upon the speaker's face, to rule out effects of glare and shadow. Subjects wrote their responses on mimeographed answer sheets.

*Second Session.*—The silent motion picture was presented to the two groups in a classroom setting. The subjects were asked to make a response for each of the 50 words presented.

## Results

*Sentence Test.*—Scores for both groups on the Utley Sentence Test were compared. The skilled group obtained a mean score of 105 words, with a range of 80-121 words out of a total of 125 words. The unskilled group had a mean score of 42 words, range 26-57 words. A *t*-test was applied to test the significance of the difference between the two means, resulting in a *t*-value of 12.25, which for 14 degrees of freedom is significant beyond the 0.01 level. Thus, the two groups were considered to be widely separated in lipreading skill.

*Word Test.*—Intelligibility scores (the percentage of the 50 words correctly recorded) were computed for each subject. Scores for the skilled group ranged from 14% to 30%, with a mean of 19.75%.

TABLE 1.—*Word Intelligibility Scores for Skilled and Unskilled Groups*

| Word | Score | |
|---|---|---|
| | Skilled | Unskilled |
| Flop | 100 | 100 |
| Wasp | 88 | 25 |
| Rough | 75 | 75 |
| Prime | 75 | 25 |
| Wife | 75 | 75 |
| Deep | 62 | 12 |
| Badge | 50 | 50 |
| Rooms | 50 | 38 |
| Best | 50 | 12 |
| Mash | 38 | 25 |
| Fee | 38 | 38 |
| Ray | 25 | 25 |
| Slouch | 25 | 12 |
| Tongue | 25 | 0 |
| Eat | 25 | 0 |
| Leg | 12 | 12 |
| Reap | 12 | 12 |
| Fowl | 12 | 12 |
| Cob | 12 | 0 |
| Grope | 12 | 12 |
| Eyes | 12 | 0 |
| Shank | 12 | 0 |
| Thigh | 12 | 0 |
| Sup | 12 | 12 |
| Thus | 12 | 0 |

For the unskilled group, scores ranged from 6%-22%, with a mean of 12.5%. The difference between the two means was not significant ($t$=1.35; $t$ .05=2.14 for 14 $df$). Although the Utley Sentence Test widely separated the two groups, the word test did not.

*Word Intelligibility.*—An intelligibility score was also computed for each word, and values for the first 25 words are listed in Table 1. From Table 1 it is evident that words containing a combination of highly visible consonants were identified by more subjects in each group. For example, the word "flop" was correctly identified by all subjects in both groups. The next four words at the top of the list are likewise composed of highly visible elements produced at or near the front of the mouth, such as "prime." The range of word scores for the skilled group was from 0 to 100% (mean 19.4%). There were 21 zero scores (words which were not identified by any of the subjects). The range for the unskilled group was 0% to 100% (mean 12.4%), with 29 scores of 0. These word scores were used in the determination of correlation coefficients as described in the following paragraph.

TABLE 2.—*Zero-Order Correlation Coefficients* Between Word Intelligibility and Word Characteristics, and Interrelationships Between Word Characteristics—Data for Both Groups*

| | Visibility | Vertical Mouth Opening | Word Frequency | Phonetic Units |
|---|---|---|---|---|
| **Skilled Group** | | | | |
| Word intelligibility | 0.55 | 0.25 | 0.22 | 0.18 |
| Visibility | | 0.36 | 0.00 | 0.22 |
| Vertical mouth opening | | | −0.13 | 0.17 |
| Word frequency | | | | −0.21 |
| **Unskilled Group** | | | | |
| Word intelligibility | 0.51 | 0.22 | 0.11 | 0.10 |

* $r$, $df$ 48: 1%, 0.36; 5%, 0.28.

*Analysis of Data by Correlation Techniques.*—In Table 2 may be seen the zero-order correlations between word intelligibility and the four selected variables for the two groups. For the skilled group, the correlation between intelligibility and visibility, 0.55, is significant at the 0.01 level. The remaining coefficients in the top row of Table 2 are small and positive (0.25, 0.22, and 0.18), with none being significant. For the unskilled group in the bottom row, the correlation of intelligibility with visibility (0.51) is also significant at the 0.01 level. The other coefficients in the bottom row of Table 2 are smaller than those for the skilled group, and none are significant. The remaining portion of Table 2 shows the inter-relationships between the four word characteristics. Only one of these is significant, that between visibility and vertical mouth opening, with a correlation of 0.36. Partial correlations and multiple correlations were also computed but failed to add any important information. The visibility variable proved to be the only important one after all possible analyses were exhausted.

*Intelligibility of Isolated Elements of Words.*—Intelligibility of each phonetic

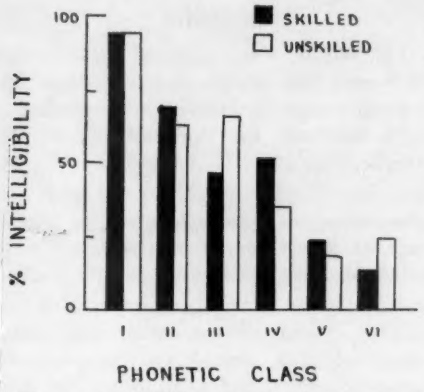


Fig. 1.—Intelligibility of phonetic classes, consonants only. The classes are *I*, labiodental sounds; *II*, labial sounds; *III*, linguadental sounds; *IV*, postdental sounds; *V*, velar sounds, and *VI*, glottal sounds.

element was determined in a manner similar to that used for words. In the list, as spoken on the film, there were 21 different consonant sounds, 10 vowels, and 3 diphthongs. The most intelligible consonants for the skilled group were [w], [f], [m], and [s]. The most intelligible vowels and diphthongs were [au], [i], [ai], and [ou]. For the unskilled group, the most intelligible consonants were [f], [w], [ø], and [p]. The most intelligible vowels and diphthongs were [au], [u], [œ], and [a], in that order.

The sounds were further analyzed into the following classes according to manner of production by the articulatory organs: labiodental, labial, linguadental, postdental, velar, and glottal. Values for elements in each of these classes were pooled and means computed, which represent the intelligibility of an entire class of phonetic elements. These means are plotted graphically in Figure 1. It is apparent that the most intelligible class of sounds was the labiodental, which includes only the sound [f] in this experiment. The least intelligible classes were the velar and glottal for both groups. It is obvious from the bar graph that the two groups were quite similar in their identification of sound classes.

*Comparison of Speech Units.*—The question was raised as to which of the speech units analyzed was most intelligible: words,

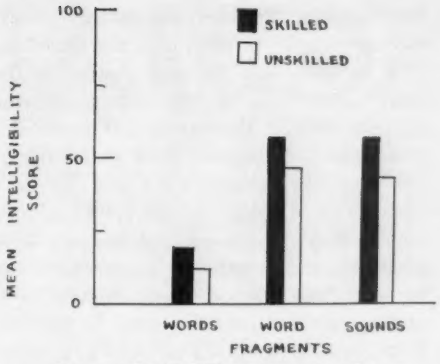


Fig. 2.—Intelligibility of speech units.

word fragments, or individual sounds. Word-fragment scores were obtained in the following manner. The percentage of the word identified was computed for each subject, and the mean percentage was determined for all subjects. For example, if the word presented was "deep" [dip] and the subject recorded "keep" [kip], he had correctly identified two out of three elements, or 67% of the word. In Figure 2 the data are presented. It shows that words were much less intelligible than the other units, whereas there was very little difference between the average intelligibility of word fragments and individual sounds. This relationship between the three speech units holds for both groups. This means that for both skilled and unskilled lipreaders the identification of individual sounds and word fragments was a somewhat simpler task than that of identifying the whole words composed of these subword units.

## Comment

The task required of the subjects in this experiment was to lipread a list of individual, isolated words. With contextual cues lacking, the identification of the words was more directly dependent upon the visibility of the phonetic elements within the words. It was a task not well suited to the requirements of the skilled lipreaders, who performed little better than the unskilled. However, when lipreading the list of sentences comprising the Utley Lip-

Reading Test, Form A, the skilled lipreaders significantly excelled over the unskilled. This suggests that the skill resides in the proper utilization of cues external to the lip movements themselves. The skilled group identified only 20% of the words of PB List No. 6, and, since this list is a representative sample of the speech sounds of conversation, it is inferred that only 20% of the discrete words of conversation can be identified. Hence, approximately 80% of the speech information must be supplied from contextual, situational, and other cues.

The findings with regard to the intelligibility of individual sounds are important. The values for the sounds are not the same as they would be if the sounds alone were presented, since one sound may be inferred frequently because of its juxtaposition to another. From Figure 2 it is surmised that the sounds which are most easily identified are those produced at the front of the mouth, such as the labial or the labiodental sounds. As the place of articulation of the elements changes from the front to the back of the mouth, the elements become less and less intelligible, owing to an obscuring of visibility. A combination of highly visible elements within a word enhances the probability of correct identification. However, even though the elements may be highly visible, the identification of the correct word is not absolutely assured, if another meaningful word containing elements that look alike on the lips might be substituted.

Experimental evidence [1,4] has shown that a more valid and reliable standardized test of lipreading is needed, especially for adults. Since a test composed only of words would not adequately differentiate between skilled and unskilled lipreaders, the major portion of the test should be composed of sentences which vary in difficulty. A word test could be constructed, however, by selecting monosyllabic words from the Harvard PB-50 series, which would discriminate between lipreaders and would range in difficulty from 0% to 100%.


## Summary

List No. 6 of the Harvard PB-50 series of monosyllabic words was selected as lipreading material. Two groups of subjects were screened for lipreading ability by means of the Utley Sentence Test, Form A, and determined to be skilled and unskilled. The two groups were required to lipread each of the 50 words of PB List No. 6, which was presented by a talker in a silent motion picture. Their performances on this difficult visual discrimination task were compared with regard to percentage of words identified and to utilization of four preselected cues related to the perceptual and linguistic attributes of the words. The following were the major findings:

1. Skilled lipreaders excel over unskilled lipreaders in lipreading a list of sentences. However, the two groups do not differ in their ability to lipread isolated words.

2. The skilled lipreader correctly identifies about 20% of the discrete words of conversation, whereas the unskilled person identifies 12%. Skill in lipreading thus resides in the degree of utilization of contextual, situational, and other cues which are external to the lip movements themselves.

3. The visibility of the total-movement form of a word is the best cue the lipreader has in identifying it. Differences in the size of the vertical mouth opening, the familiarity of the word, and the phonetic length of one-syllable words are not significantly utilized in this type of task.

4. The visual identification of phonetic elements of words is directly related to the place of articulation of the element. As the place of articulation moves from the front to the back of the mouth the intelligibility of the elements becomes less and less.

5. Further controlled experiments are needed which compare different types of materials for lipreading and determine individual difference variables contributing to varying degrees of skill.


204 Lowry Lane.

## REFERENCES

1. DiCarlo, L. M., and Kataja, R.: An Analysis of the Utley Lip-Reading Test, J. Speech & Hearing Disorders 16:226-240, 1951.

2. Egan, J. P.: Articulation Testing Methods II, Psycho-Acoustic Laboratory, Cambridge, Mass., Harvard University Press, OSRD Report No. 3802, 1944.

3. Gault, R. H.: On the Identification of Certain Vowel and Consonantal Elements in Words by Their Tactual Qualities and by Their Visual Qualities as Seen by the Lip-Reader, J. Abnorm. & Social Psychol. 22:33-39, 1927.

4. Heider, F., and Heider, G.: An Experimental Investigation of Lip-Reading, in Studies in the Psychology of the Deaf, Psychol. Monog. 52:124-153, 1940.

5. Kitson, H. D.: Psychological Tests for Lip-Reading Ability, Volta Rev. 17:471-476, 1915.

6. Kodman, F., Jr.: An Investigation of Word Intelligibility as a Function of Time Compression, Ph.D. Dissertation, University of Illinois, 1954.

7. O'Neill, J. J.: Contributions of the Visual Components of Oral Symbols to Speech Comprehension, J. Speech & Hearing Disorders 19:429-439, 1954.

8. Pauls, M. D.: Speech Reading, in Davis, H.: Hearing and Deafness, New York, Rinehart & Company, Inc., 1951.

9. Pintner, R.; Eisenson, J., and Stanton, M.: The Psychology of the Physically Handicapped, New York, Appleton-Century-Crofts, Inc., 1941.

10. Saltzman, M.: Factors in Learning Speechreading, A. M. A. Arch. Otolaryng. 65:425-427, 1957.

11. Thorndike, E. L., and Lorge, I.: The Teacher's Word Book of 30,000 Words, New York, Columbia University Press, 1944.

12. Utley, J.: Development and Standardization of a Motion Picture Achievement Test of Lip-Reading Ability, Ph.D. Dissertation, Northwestern University, 1956.

Case Reports

# Unusual Tumors of the Nose

STEPHEN F. BALSHI, M.D., Philadelphia

During the past year, we of the Otolaryngological Service of the Jefferson Medical College Hospital have had the privilege of treating some unusual tumors of the nose. To be specific, we have had a neurofibroma of the nasal vestibule, a squamous-cell carcinoma of the turbinate, a lymphosarcoma of the turbinate, a chondrosarcoma of the nasal septum, and a mixed tumor of the floor of the nose.

Tumors of the nose, whether benign or malignant, are rare. The incidence of malignancy in the nose, and paranasal sinuses is 2% of all malignancies, according to Ash and Raum.[1] Benign lesions are considered to be rarer than malignant lesions.

Early diagnosis is an important factor in the management of lesions of the nose because removal may be complete and conservative when the lesions are small. Later, only palliative or severely mutilating surgery can be offered.

This presentation will be a limited discussion of entities to be considered in the differential diagnosis of the cases to be presented.

In the differential diagnosis of lesions involving the nose the following conditions must be considered: (1) inflammatory or allergic lesions; (2) congenital tumors and cysts; (3) benign tumors; (4) malignant tumors.

Early, both benign and malignant lesions exhibit a paucity of symptoms. Nasal discharge may be mucoid, purulent, or blood-tinged. Intermittent bouts of epistaxis which occur spontaneously in a previously normal person should arouse suspicion. Unilateral bleeding, discharge, or obstruction is more significant than bilateral and is probably the earliest symptom to be expected.

*Pain* or *paresthesia* initially may be vague and minimal and usually involves some branch of the first or second division of the trigeminal nerve. It is often referred to the cheek, under the eye, or deep to the eye.

*Swelling* of the bridge of the nose and lateral aspects of the nose, like pain, is a late symptom. Should the tumor involve the maxillary antrum, the floor of the nose, or the superior alveolar ridge, swelling in the roof of the mouth may be a noticeable symptom. In edentulous patients there may be swelling of the upper lip or in the vestibule of the nose. Unilateral exophthalmos and nasal obstruction are common in diseases involving the ethmoid sinuses. Some nasal tumors produce obstruction of the lacrimal duct, and excessive tearing results.

*Ulceration* occurs fairly early in malignant epithelial tumors. Sarcomas tend to bleed easily when manipulated and may be reddish and polypoid in contrast to the firm grayish nodular carcinomatous lesions. Benign lesions are usually soft, nontender, and show less tendency to bleed easily.

Routine x-ray views of the nose and sinuses have long been a valuable tool in diagnosis.

*Planograms* may lead to earlier diagnosis of both benign and malignant lesions. When used in advanced cases it is helpful in outlining the growth, the extent of bone involvement, the amount of displacement, decalcification, and absorption of bony

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walls. It is one of the best guides in judging the operability of a case.

Biopsy is the most important diagnostic procedure. Electrocoagulation may be used to seal cut edges. Often repeated biopsies are necessary to arrive at the proper diagnosis, especially when benign polyposis is concurrent.

"Mixed tumors" may originate in the nasal cavities, nasopharynx, paranasal sinuses, and palate, as noted by Owens [2] in his survey of the literature over 20-year period. It is of interest to note that in Owens' series mixed tumors of the nose were next in frequency to those of the palate. Since squamous-cell carcinoma is relatively rare within the hard and soft palate, the probability of a tumor in this area being a mixed tumor is great. McDonald and Havens [3] in their series also note that a large percentage of "mixed tumors" occur in the nasal cavity.

The so-called "mixed tumors" exhibit pleomorphism as a prominent feature, and many varieties of structure may be found in one tumor. They may resemble simple adenomas, on the one hand, and malignant anaplastic carcinoma, on the other. In general the growths outside of the major salivary glands tend to be more malignant than those in or near them. Although most often classed as benign tumors, they have been demonstrated microscopically to possess such malignant characteristics as nonencapsulation, infiltration of surrounding tissue, recurrence after seemingly adequate removal, and occasional metastasis. In aberrant locations it would be best to consider them as low-rate malignant adenocarcinomas regardless of histologic structure. Even when the tumor appears clinically encapsulated, microscopic examination commonly reveals extension into the surrounding area, making it unsafe to perform conservative excision.

The majority of malignant tumors of the nose are of the epidermoid type. The carcinomas that originate in the nose, particularly in the turbinate and ethmoid area, show a greater tendency to squamous-cell differentiation than do those arising in the sinuses. Next in frequency would be the transitional-cell type. Malignant tumors of the nose and sinuses metastasize less freely than do those of the nasopharynx but they tend to involve large portions of contiguous tissue by invasion and pressure.

The frequency of malignant connective-tissue tumors is difficult to ascertain, for many cases of malignant nasal tumors in the past were called sarcoma with no specific mention as to the type and often included highly undifferentiated carcinoma.

Sarcomas apparently arise from periosteum or lymph structures. Excepting osteogenic sarcoma, they are generally soft polypoid reddish smooth masses. Spindle-cell sarcoma tends to ulcerate, a feature not common to the others.

Chondrosarcoma rarely involves the nasal septum or paranasal sinuses. A case presented by Lawson [4] in 1953 and one by Soboroff and Lederer [5] in 1955 in this country are the most recent reported in the literature. A case involving the nasal septum is being presented in this paper.

Chondrosarcoma is histologically of cartilaginous orgin and is differentiated from benign chondroma by the presence of anaplastic cells and tendency to metastasize. Primary and secondary types are described. The primary type arises from relatively undifferentiated cells in perichondrium, while the secondary type, which is the commoner, often arises from cartilage rests remaining in the central portion of bone after ossification has occurred. Primary chondrosarcoma usually occurs in young patients, and a striking feature is the development of metastasis and extension into veins. Secondary chondrosarcoma usually develops in the 30-50-year age group.

These tumors are usually insensitive to radiation therapy, and surgical excision, if feasible, should be attempted.

The lymphosarcomas are extremely rare in the nasal cavities as distinguished from the nasopharynx. Harrison [6] reports two

cases originating in the ethmoid sinuses. We are reporting one originating in the nasal mucosa on the inferior turbinate. These tend to metastasize readily both to the neck and to distant organs. Radiation therapy is usually employed exclusively in lymphosarcoma and the round-cell type of sarcoma.

Myxosarcoma is usually a slow-growing tumor that tends to occur in young people and carries a good prognosis since it does not usually metastasize.

Plasmacytoma is a rare destructive tumor of the nose characterized by rapid and early metastasis to bone.

Malignant melanoma occurs principally on the septum or lateral nasal wall. Ringertz[7] reported 41 cases of melanoma involving the nasal cavity. These tumors require wide surgical excision. While they respond to radiation, the prognosis is poor.

In general, fibrosarcoma, chondrosarcoma, spindle-cell sarcoma, and osteogenic sarcoma are only slightly radiosensitive. In these, ultimate prognosis is poor despite combined surgery and radiation.

With benign lesions such as neurofibromas, nasoalveolar cysts, fibromas, osteomas, and papillomas, adequate surgical excision or electrocautery usually is curative.

Tumors of questionable malignancy, such as mixed tumors, should be treated by wide local excision when this is possible. When radiation is used there is variable reduction in size with subsequent growth. Routine radiation after excision is not indicated. Radiotherapy should be used to palliate inoperable tumors and postoperatively only for recurrences that cannot be surgically excised. The surgeon should consult with the radiologist and indicate the areas of questionable removal or extent of recurrence to avoid indiscriminate spraying of a large operative defect by x-rays.

Sarcomas of the lymphatic series are usually best treated by radiation and chemotherapy without surgery. Preliminary chemotherapy, such as nitrogen mustard, has been reported to reduce associated pain.

Fibrosarcoma, chondrosarcoma, spindle-cell sarcoma, and osteogenic sarcoma should be adequately excised if possible. Radiation should be reserved for inoperable cases and postoperative recurrences that cannot be removed by further surgery.

Radical surgery of the nose and paranasal sinuses in the past usually consisted of exposure of the neoplasm, removal of the visible tumor, often piecemeal, and electrocautery to the walls of the resulting cavity. This form of surgery is now largely replaced by en bloc dissection of an area containing tumor and if necessary the sacrifice of an eye, nose, or maxillae. The ultimate goal is to cut through normal tissue at all times in hope of excising the tumor completely. Diathermy is mainly reserved for hemostasis rather than tumor destruction. It is well known that once malignant tumor invades the bone marrow spaces it is very difficult to treat by either radiation or surgery.

In general, the therapeutic regimen for malignant epithelial tumors is as follows:

1. Radical surgical excision alone.
2. Excision followed by irradiation or radium implantation.
3. Excision followed by radiation to limited areas of the operative site where questionable or proved residual tumor exists.
4. Inoperable cases should receive palliative radiotherapy, and many centers now employ cobalt teleradiation.

Brief mention will be made of results of surgical and radiation therapy in the past and to the present day.

Schall,[8] Cranmer,[9] Struben,[10] and Larsson and Maartensson,[11] reporting on cases treated with combined surgery and radiotherapy, reveal five-year survival rates ranging from 22% to 45%.

## Conclusion

In conclusion, one can say the attitude toward radical surgery of the nose and paranasal sinuses is changing. Formerly the operative mortality was high, and the many complications due to poor anesthesia, shock, blood loss, electrolyte imbalance, and severe sepsis were severe. As a result,

radiotherapy was often used exclusively as the preferred treatment. Today, with antibiotics, adequate preoperative preparation, excellent diagnostic and radiologic aids, we can better evaluate and select cases for operation.

With the excellent rehabilitation program that can be offered the surgical patient in the way of adequate prosthetic appliances, and economic and social readjustment through welfare agencies, the once-doomed surgical cripple can now be returned to an active social life.

## Report of Cases

CASE 1.—Negro woman, age 70. Diagnosis: neurofibroma, right nasal vestibule. Chief complaint: swelling of the right side of the nose.

*History of Present Illness.*—This 70-year-old Negro woman gave an admission history of having been in an auto accident four years prior to admission, at which time she sustained a fracture of the nose. She was asymptomatic until four months prior to admission, when she noted a progressively enlarging firm swelling in the right nasal vestibule to the point of complete obstruction on the right side. There was no pain, discharge, or epistaxis.

Previous medical history, family history, and systemic review were noncontributory.

*Physical Examination.*—A large cyst-like swelling completely occluded the nasal vestibule on the right side. This began at the nasoalveolar process, appeared to be limited by the junction of the nasal mucosa and skin anteriorly, and superiorly extended to the inferior turbinate and medially to the nasal septum. It was very firm to touch and did not appear inflammatory in nature. No other tumors were found in the physical examination.

All laboratory studies and x-ray of chest and sinuses were normal.

The mass was excised by dissection through a buccal incision, medial to the canine fossa. It was delivered in toto and was found to be encapsulated and had a rubbery feel. When opened it was found to be a solid tumor mass.

*Histologic Diagnosis.*—Neurofibroma of the right nasoalveolar area (Fig. 1).

The patient was discharged March 30, 1957, and has been asymptomatic and free of any recurrence to date.

CASE 2.—Man, age 66, was admitted to the E. N. T. Service on Aug. 26, 1956. He had bleeding from the right side of the nose and a mass in the roof of his mouth one month prior to admission, which has been gradually increasing in size and was nontender; there was no ulceration or bleeding from the mouth. He had experienced medium slight nasal obstruction with three episodes of epistaxis. It is of interest to note that he had been admitted in 1944 for removal of a mass in the superior maxilla, and again in 1951

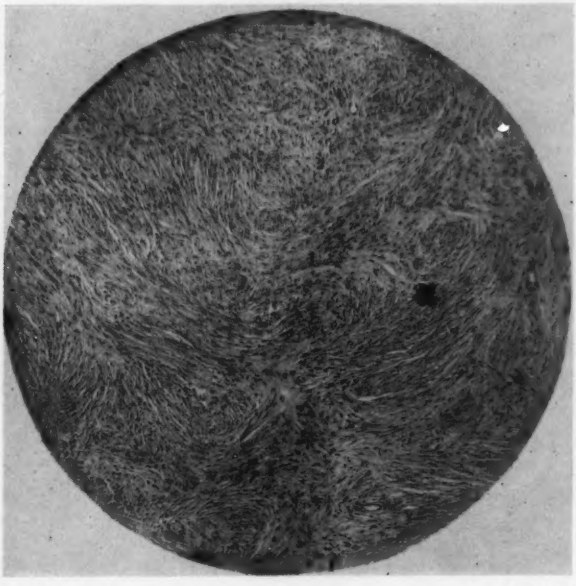

Fig. 1.—Neurofibroma, nasal vestibule. Interlacing bundles of spindle cells exhibiting palisading of the nuclei.

there was a recurrence of the mass, which was again removed.

*Physical Examination.*—Findings are limited to the nose and oropharynx. In the right nostril a protruding mass appeared to obliterate the right nasomaxillary fold. The roof of the mouth on the right side presented a mass the size of a quarter, which was soft to touch, did not bleed, and was located behind the incisor and right canine teeth. Remainder of the physical examination was nonrevealing.

Laboratory studies were within normal limits. X-ray of the sinuses: a diffuse opacity in right maxillary sinus.

On Aug. 21 the patient was operated upon under general anesthesia, and the right maxilla was partially resected as was two-thirds of the hard palate. The tumor mass appeared to arise from the hard palate.

*Histologic Diagnosis.*—Mixed tumor of minor salivary glands of the hard palate (Fig. 2).

On Sept. 11, 1956, he was readmitted and fitted for a dental prosthetic appliance and on Sept. 13 he was discharged.

On Nov. 6, 1957, he was readmitted because of recurrent episodes of bleeding in the roof on the right side of the mouth. Examination revealed recurrent tumor mass along the margin of the remaining maxilla. He was again taken to the operating room, and further resection of the maxilla was carried out to what was felt was beyond the extent of the tumor margin. This was performed with electrosurgery. Patient again had an uneventful recovery and was discharged Nov. 13, 1957. He has been asymptomatic since discharge.

CASE 3.—White woman, age 67. Chief complaint: "Can't breathe through the right side of the nose."

*History of Present Illness.*—This patient was in fairly good general health until December, 1955, when she developed an acute upper respiratory infection. She was treated by L. M. D., and this cleared in two to three weeks, but the obstruction in the right side persisted to the present date of admission Aug. 16, 1956 (nine months). In the month prior to admission she began to note pain in the right side of the neck behind the ear. Patient had no history of allergy; also stated the nostril bled very easily if a physician would examine her nose. There was no weight loss. Family and past medical history were noncontributory.

*Physical Examination.*—On physical examination positive findings were limited to the right nasal cavity. The right nostril revealed a necrotic, proliferating, foul-smelling mass projecting from the posterior inferior portion of turbinate with a small bleeding ulcerated area on its surface. Left nasal cavity was normal. Nasopharynx: The mass in the right nostril appeared to extend into the nasopharynx, projecting behind the inferior turbinate. No cervical adenopathy was noted on admission. Clinical impression was malignant tumor, right inferior turbinate and nasopharynx.

The laboratory studies on admission: CBC, urinalysis, blood sugar, serology, EKG, and chest x-ray were within normal limits. On Aug. 16 an x-ray of the paranasal sinuses was performed, including the frontal, ethmoid, and maxillary sinuses, and

Fig. 2.—Mixed tumor of minor salivary gland showing a dispersion of epithelial cells in bands with tubular formation in a limited hyaline stroma.

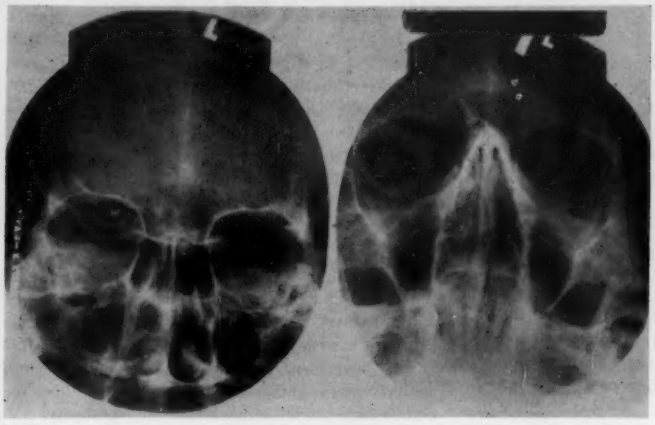

Fig. 3.—X-ray of sinuses showing obstruction of right nasal cavity.

the sphenoid sinuses. There was almost a complete opacification of the soft tissues of the nasal passageway on the right side. No other abnormality was noted (Fig. 3).

On Aug. 21 a biopsy was performed on the lesion of the right inferior turbinate, and the pathologist reported it as malignant tumor involving the right inferior turbinate, probably lymphosarcoma (Fig. 4).

The patient was seen in consultation with the radiotherapist at the Jefferson Hospital, Dr. S. Kramer, who stated that, in view of the very undifferentiated nature of the tumor, she should have deep x-ray therapy. He advised beginning with large fields to include lymph-node drainage areas and then to continue with small fields directed to the primary lesion. She was given a complete course of radiation as an outpatient. During radiation to the nose and nasopharynx between Aug. 22, 1956, and Sept. 28, 1956, she received a tumor dose between 5,000 r and 5,500 r. The glandular areas of her neck were irradiated between Oct. 15, 1956, and Nov. 8, 1956, and received a tissue dose of 3,200 r.

Her last visit in March, 1958, revealed the patient free of any lesion in the turbinate, or nasopharynx. No glands palpable. Clinically: leading a normal life.

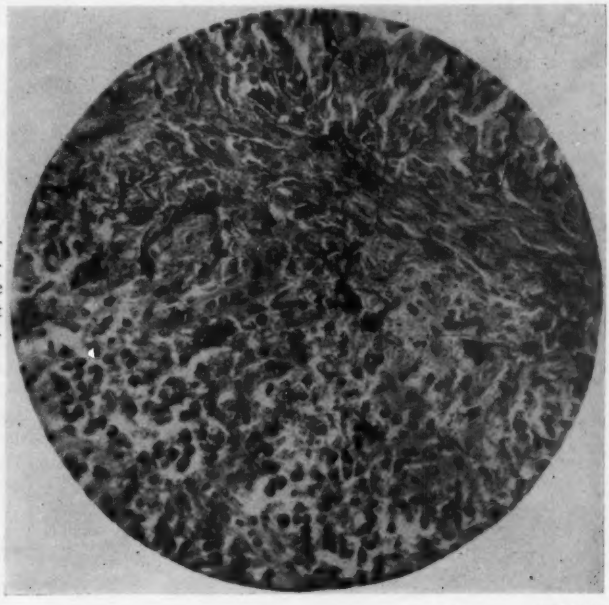

Fig. 4. — Lymphosarcoma, inferior turbinate (high power). Primitive lymphoid cells with large round to ovoid nuclei and scant cytoplasm growing in a disorganized invasive fashion.

CASE 4.—White man, age 76.

This white man, age 76, was seen at Jefferson Hospital for the first time Oct. 23, 1956, because of an enlargement on his nose. He had been receiving antibiotic therapy from his family physician, but the lesion failed to regress. He first noted a lesion on the dorsum of the nose one month ago. This was intermittently painful and associated with obstruction, particularly of the right side, in the past few weeks. No epistaxis or purulent nasal discharge noted. A biopsy was performed.

*Previous Medical History.*—Prostatectomy, 1911. Syphilis, 1950—received penicillin therapy.

*Physical Examination.*—Pertinent positive physical finding was a large indurated area on the bridge of the nose with an area of necrosis in the center.

*Laboratory Studies.*—Normal blood count, urinalysis, blood sugar, and BUN. Serology was positive (4+) on repeat tests.

X-ray of the facial bones and nasal bones revealed a destruction of the distal half of the nasal bones. One isolated fragment from the region of the tip of the nasal bone appeared to be sequestrated. Impression: Destruction of the distal part of the nasal bones possibly by direct invasion of neoplasm from adjacent structure. Possibility of osteomyelitis must be considered.

On Oct. 26, 1956, a punch biopsy of the lesion on the nose was reported as squamous-cell carcinoma of the nose, intermediate grade.

On Oct. 31 a surgical excision of the entire nose was performed under general anesthesia. The specimen included all of the projecting portion of the external and internal nose. The histological report was squamous-cell carcinoma of the nose, well differentiated. The tumor appeared to originate in the mucosal surface and extended into the basal layer of the skin (Fig. 5). Complete excision is difficult to ascertain—reported by Dr. P. Jernstrom, pathologist. Patient made an uneventful recovery and was discharged to the Outpatient Department for follow-up on Nov. 21, 1956.

On Dec. 21, 1956, the patient was readmitted after a positive biopsy report of tissue taken from the right ethmoid area. Paranasal sinuses were again x-rayed and were reported as abnormally dense right frontal and ethmoidal sinuses probably due to chronic infection. However, the patient was again submitted to surgical exploration, and the right lateral maxillofrontal area and posterior portion of middle turbinate were resected. When the cribriform plate area appeared soft and necrotic, resection was discontinued, for it was felt this was the result of tumor extension and bony necrosis in this area. The patient was then referred for radiotherapy. He received a full tumor lethal dose consisting of two portals 4×6 anteriorly and 4×6 posteriorly. Total dose of 5,550 r between Jan. 2, 1957, and Feb. 5, 1957; 4,500 r over period of 38 days to right cheek.

The patient appeared to do well until September, 1957, when the right maxillary area adjacent to the operative defect again became involved with recurrent carcinoma. It was now decided to admit the man for radical surgical excision of the right

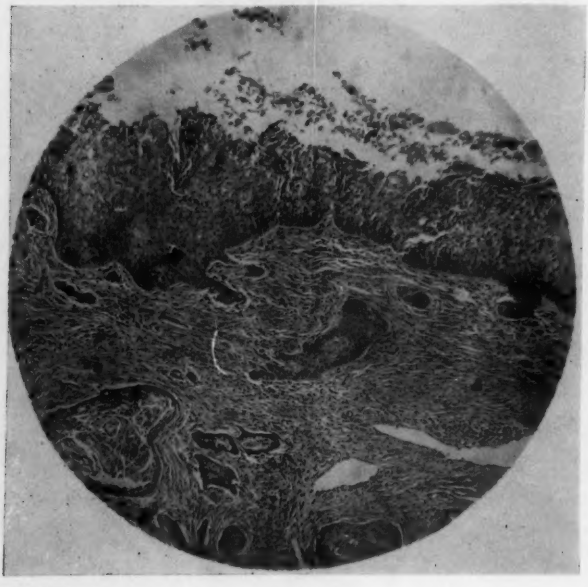

Fig. 5.—Squamous-cell carcinoma, nose (low-power magnification). Nests of anaplastic squamous epithelial cells growing invasively and forming "pearls" in the submucosal stroma.

maxilla and right orbital contents, the right ethmoid sinuses, and right hard palate.

On Sept. 11, 1957, the radical surgical excision of the right orbit, maxillary sinus, and ethmoids was carried out under general anesthesia. The patient withstood the procedure well, and a split-thickness graft was used to line the cavity. He was maintained initially by tube feeding and subsequently, with the fitting of a dental prosthesis for the hard palate, the patient became self-sufficient.

Histologic report on tissue revealed squamous-cell carcinoma involving the skin and subjacent muscle of the right cheek, well differentiated. There is no involvement of ocular, orbital or osseous tissues. The tumor appears to be completely excised.

Patient has made an uneventful recovery, is ambulatory and does not appear to exhibit signs of recurrence of tumor to date, July, 1958.

In retrospect, it was the consensus of the department that initially more extensive radical surgery would have been the preferred treatment.

CASE 5.—White man, age 31. Diagnosis: intranasal chrondrosarcoma. Chief complaint: loss of vision of the right eye and a stuffy nose, right side.

*History of Present Illness.*—This patient was well until December, 1956, when he noted a severe headache, nausea, and vomiting. He was admitted for study to the Nazareth Hospital, Philadelphia, in January, 1957, and was seen by a neurosurgeon and general medical staff. At that time skull x-ray, arteriogram, and lumbar puncture were within normal limits. One month after the initial onset his vision improved and returned to normal. His diagnosis at that time was optic neuritis. He was asymptomatic until March 1, 1957, when he began to experience double vision and he was then admitted to the Wills Eye Hospital in April, 1957. At this time he was noted to have diplopia and optic atrophy of the right eye. He had all studies repeated, and again they were reported as normal, except for the spinal fluid protein, which was 30 mg. higher than in January, 1957. Diagnosis at this time was myasthenia gravis, multiple sclerosis, or intracranial neoplasm. The patient was discharged with no definite diagnosis.

In the latter part of August, 1957, the patient began to experience difficulty with a "stuffy nose," and an examination by an otolaryngologist revealed no abnormal findings despite the fact that he complained of loss of smell, nasal obstruction, and decreased visual acuity now in both eyes.

In September, 1957, he was referred to the Neurological Service of the Jefferson Hospital, and on this admission the neurologist reported the following positive findings: (1) right abducens nerve paralysis; (2) optic atrophy right optic nerve; (3) bilateral reduction in visual acuity; (4) temporal and inferior visual-field constriction and questionable scotoma in the right; (5) loss of sense of smell on the right side.

After the neurological evaluation the E. N. T. department was asked to evaluate this man, Sept. 30, 1957, for the first time for the question of a possible tumor mass in the nasopharynx.

On Sept. 30 E. N. T. department consultation revealed that the left nasal vestibule presented a deviated septum to the left with a hard mass on the middle turbinate extending medially to the nasal septum. Right nasal cavity was completely occluded, and there was a question as to whether it was septal deviation or tumor replacing septum.

Nasopharyngeal examination revealed a mass occluding the left choana. Planograms and biopsy of the nasopharyngeal mass were recommended. It is of interest to note that an initial x-ray of the sinuses was reported as normal. However, on subsequent reevaluation radiologically, the radiologists report complete opacification of the sphenoid sinus, and posterior ethmoids. There is destruction of the floor of the sella and the base of the dorsum sellae. A large mass is visualized within the nasal passageway. There is a deviation of the septum to the right. The inferior portion of the septum is apparently destroyed. Hyperaeration of the paranasal sinuses is noted. Special views of the optic foramen show the right optic foramen to be intact; however, the left inferior wall of the optic foramen is eroded. Impression: Best roentgen possibility is a mucocele of the sphenoid sinus with extension into the posterior ethmoids and along the base of the skull.

The biopsy of the nasopharynx revealed the tissue to be cartilaginous in texture. Initially there was some question as to whether it was a benign chondroma, but after repeated sections were examined it was the consensus of the pathology department that the final histologic diagnosis was chondrosarcoma, well differentiated, of the nasopharynx (Fig. 6).

On Oct. 9, 1957, under general anesthesia the patient was operated upon. It was decided to attempt to approach the lesion initially by splitting the soft palate. This was done. However, it was noted that adequate exposure and accessibility to the mass would not be achieved through this exposure, so the lesion was exposed via bilateral Caldwell-Luc exposure. It was then noted the tumor mass appeared to replace practically the entire nasal septum; it had eroded the floor of the left and right orbits, and the right medial wall of the maxillary antrum. The tumor mass was exenterated with difficulty by freeing it from the mucous membrane, laterally and inferiorly. Superiorly it extended up toward the cribriform plate and posteriorly into the sphenoid sinus area. It was removed by blunt dissection in its entirety,

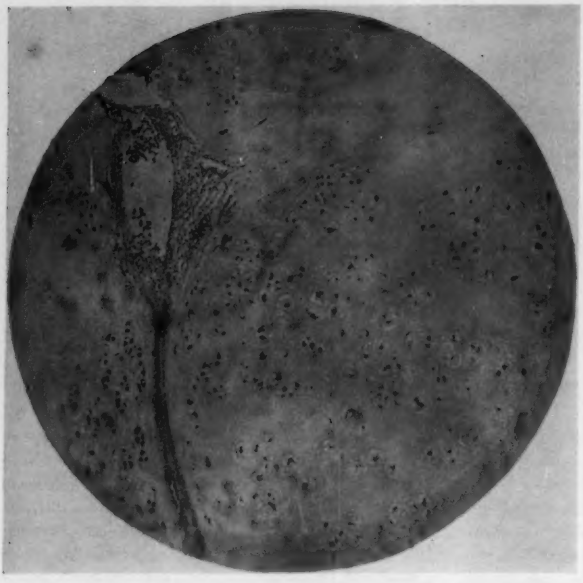

Fig. 6.—Chondrosarcoma, nasal septum. Lacunae containing single and multiple large and small bizarre cells in a hyaline matrix.

except for a question of a few small remnants remaining attached to bone on the inferior and lateral bony orbital walls. The bleeding was controlled with electrocoagulation and packing, and the patient withstood the procedure well.

Twelve hours postoperatively the patient showed externally a large amount of soft-tissue swelling, periorbital and generalized facial edema. He experienced a sudden shock-like reaction. Blood pressure dropped to 40/20; however, he did not lose consciousness at any time. It was felt he developed a neurogenic shock-like reaction due to postoperative trauma and edema about the pituitary and hypothalmic area. His shock-like reaction was finally controlled with oxygen, levarterenol (Levophed), and cortisone. He was covered with broad-spectrum antibiotics, chloramphenicol (Chloromycetin) and novobiocin, and in one week exhibited normal postoperative convalescence.

During the convalescence he was seen in consultation by the radiotherapy department, and it was their opinion that immediate postoperative radiation should begin. However, the neurologist and the otolaryngologists felt that it would be well to wait and watch the patient's progress and begin therapy if evidence of local recurrence should occur. This decision was rendered in the face of the severe postoperative course; the patient should not be exposed to further prospects of edema in the pituitary region and the medulla.

He was discharged Nov. 16, 1957, and has been observed at weekly intervals to date. His vision has returned to normal, and he is now back at work. No evidence of recurrence to date, July, 1958.

Jefferson Medical College Hospital (7).

## REFERENCES

1. Ash, J. E., and Raum, M.: Atlas of Otolaryngic Pathology, Armed Forces Institute of Pathology, American Academy of Ophthalmology and Otolaryngology and the American Registry of Pathology, 1956, p. 235.

2. Owens, H.: Minor Salivary Gland Tumors in Respiratory Tract and Ear, Laryngoscope 59: 960, 1949.

3. McDonald, J. R., and Havens, F. Z.: A Study of Malignant Tumors of Glandular Nature Found in the Nose, Throat and Mouth, S. Clin. North America 28:1087, 1948.

4. Lawson, L. J.: Intranasal Chondrosarcoma, A. M. A. Arch. Otolaryng. 57:228, 1953.

5. Soboroff, B. J., and Lederer, F. L.: Chondrosarcoma of the Nasal Cavity, Ann. Oto. Rhin. & Laryng. 64:718, 1955.

6. Harrison, D. F. N.: Two Cases of Lymphosarcoma of the Ethmoid, J. Laryng. & Otol. 67: 225, 1953.

7. Ringertz, N.: Pathology of Malignant Tumors Arising in the Nasal and Paranasal Cavities and Maxilla, Acta oto-laryng., Supp. 27:1, 1938

8. Schall, L. A.: Cancer of the Nose and Nasal Sinuses, Laryngology 53:240, 1943.

9. Cranmer, L. R.: Malignant Neoplasms of the Paranasal Sinuses, A. M. A. Arch. Otolaryng. 58:704, 1953.

10. Struben, W. H.: Malignant Tumors of Paranasal Sinuses: Treatment and Results, Ann. Otol. Rhin. & Laryng. 66:754, 1957.

11. Larsson, L. G., and Maartensson, G.: Carcinoma of the Paranasal Sinuses and the Nasal Cavities, A Clinical Study of 379 Cases, Treated at Radiumhemmet and the Otolaryngologic Department of Karolinska Sjukhuset, 1940-1950, Acta radiol. 42:149, 1954.

# Lye Burns of the Esophagus Treated with Steroid Therapy

*Rupture of Esophagus Following Bougienage*

WILLIAM DesPORTES, M.D., and EDWARD S. RAY, M.D., Richmond, Va.

In 1956, a report [1] of our experience with steroid therapy of lye burns of the esophagus was published. In that report there were 10 cases of lye burns of the esophagus treated within 48 hours of the ingestion of lye, and in none of these did a stricture of the esophagus develop. There was one case that was not treated for several days after the lye burn, and this case developed a stricture that required bougienage on four occasions. The report was cautious in its advocacy of steroid therapy in lye burns because of the possibility of mediastinitis and because of other potential dangers. However, we were encouraged by the initial results, and we have continued to use this form of therapy without serious complication except for the case here reported.

The purpose of this case report is to present the gross appearance of an esophagus severely burned by lye while under treatment with prednisone and also to point out the danger of passing bougies through an acutely burned esophagus while the patient is receiving steroid therapy.

## Report of Case

A 57-year-old white man was admitted to the medical service of the Medical College of Virginia Hospital, on Sept. 17, 1957. Several hours prior to his admission, he had swallowed approximately 2 oz. of a mixture of lye and water during a period of postalcoholic depression. At the time of his admission he was complaining greatly of pain in the mouth, throat, and epigastrium. He was expectorating thick bloody sputum and complained a great deal of pain on swallowing.

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Department of Medicine, Medical College of Virginia.

His past history revealed that he had a bleeding duodenal ulcer 10 months previously, which had been treated medically and had been asymptomatic for several months.

Initial examination revealed fairly severe burns of his lips, tongue, and mucous membranes of the mouth and pharynx. There was epigastric muscle guarding and tenderness on palpation. The remainder of the physical examination was essentially negative.

Initial treatment consisted of the administration of 15 cc. of olive oil every 15 minutes for approximately 4 hours; narcotics were given at 2- to 3-hour intervals because of severe pain on swallowing. He was given a mixture of streptomycin and penicillin (Combiotic) every six hours. The administration of steroid therapy was deferred because of the severity of the burn and because of a febrile reaction which suggested the possibility of early mediastinitis or pneumonitis. At the end of 12 hours his temperature had returned to normal, and, although he was complaining a great deal of pain on swallowing, he was able to take a Sippy I diet. At this time prednisone was started; he was given 10 mg. every six hours. At the end of three days this was reduced to 10 mg. every 12 hours. His pain gradually subsided, and after the third day he was able to take a liberal ulcer diet, which he tolerated very well except for slight discomfort on swallowing. He also complained of some sticking of food in his upper esophagus, but this was not marked. Because of the persistence of discomfort, an upper gastrointestinal series was carried out, on the 14th hospital day, which revealed a stricture at the level of the aortic arch which extended 10 cm. in length. There was no roentgen evidence of reactivation of the duodenal ulcer.

Because of the presence of a stricture and since the patient was to be discharged after a few additional days, it was felt that the stricture should be dilated. Past experience with the patient indicated that he probably would not return for follow-up study, and this influenced the decision to pass sounds prior to his discharge. On the 16th hospital day, bougienage was carried out, with a

slight obstruction noted 19 cm. from the incisor teeth. A 31 F. sound was passed easily, and this was followed by the passage of a 37 F. sound. After the passage of the 37 F. sound the patient complained of epigastric pain, and he developed muscle spasm in the upper abdomen. An iodized oil (Lipiodol) swallow revealed an anterior perforation of the esophagus at the level of the ninth dorsal vertebra. A thoracotomy was performed, and it was noted that the esophagus appeared very soft, friable, and edematous; muscle tone was poor. Because of these changes it was felt that it would be impossible to repair the tear. Consequently, drainage of the mediastinum was carried out, and a gastrostomy was performed. His postoperative course was very satisfactory, and he was afebrile after 48 hours.

## Summary

A case is reported of perforation of the esophagus by bougienage of a patient with a recent lye burn who was on prednisone. The appearance of the esophagus at thoracotomy revealed edematous tissue with little or no evidence of scar formation. Experience with this particular case indicates that the passage of esophageal sounds of lye burns of the esophagus while the patient is under treatment with prednisone should be deferred for at least two to four weeks after the discontinuance of the steroid therapy. When an esophageal stricture is suspected because of dysphagia or x-ray evidence, it is advisable to have the patient swallow a thread, but any bougienage should be deferred for at least two to four weeks after the steroid therapy has been discontinued. The gross appearance of the esophagus in this case at the time of thoracotomy did not suggest stricture formation, and it is possible that this case would have developed only a mild degree of stricture formation.

Medical College of Virginia Hospital (Dr. Ray).

## REFERENCE

1. Ray, E. S., and Morgan, D. L.: Cortisone Therapy of Lye Burns of the Esophagus, J. Pediat. 49:394-397 (Oct.) 1956.

# Treatment of Lateral Nasal Wall Tumors Through Lateral Rhinotomy Approach

BERNARD M. KRAMER, M.D., and GORDON McCOY, M.D., San Francisco

It is the purpose of this case presentation to emphasize several concepts previously mentioned by different authors of the value of the lateral external approach to lateral nasal wall tumors and to portray the characteristics of the neuroblastoma type of tumor of the nasal cavity of which this case is representative.

Lateral rhinotomy offers excellent exposure of the entire nasal cavity, with a resulting scar that is cosmetically very acceptable. The utilization of the rhinoplastic technique allows reflection of the entire nasal bone with its subsequent return intact to its original position. A technique of decreasing the amount of hemorrhage will be described.

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From the Division of Otorhinolaryngology, University of California School of Medicine.

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Since Schall and Lineback [12] reported three cases of intranasal neuroblastoma in 1951, Fisher,[3] Seaman,[13] and McCormack and Harris [9] have added a total of seven more and Frühling and Wild [4] have added four cases to the American literature. While the great radiosensitivity of these tumors is widely heralded, the high rate of postirradiation recurrence is equally stressed, this regrowth often occurring many years after the completion of therapy. That the lateral rhinotomy type of surgical attack on neurogenic tumors of the nose is feasible has been well demonstrated by McCormack and Harris.[9] The case under discussion represents a recurrence long after completion of external irradiation, which was treated by excision through the lateral-rhinotomy approach, with excellent cosmetic results and total extirpation of the lesion with adequate surrounding normal tissue.

Figure 1

Figure 2

Figure 3

## Report of Case

The patient, a 27-year-old white woman, presented herself with a history of having had 2,000 r delivered to a histologically proven neuroblastoma of the right nasal fossa eight years previously. Recent biopsy, by an otolaryngologist in another part of the country, had proven the presence of a recurrence. Physical examination revealed a tumor in the region of the natural ostium of the maxillary sinus on the right, measuring about 1×2×2 cm. X-ray examination of the sinuses revealed a mass on the medial wall of the right maxillary antrum at about the level of the mass seen in the nose (Fig. 1). Surgical excision was advised.

Under general anesthesia a subperichondrial dissection of the mucous membrane of the nasal septum on the involved side was performed and it was carried to the dorsum of the nose (Fig. 2).

Figure 4

Figure 5

Figure 6

Figure 7

Through this space elevation of the soft tissues of the dorsum from the underlying bone was obtained with a plastic scissors (Fig. 3). Medial osteotomy of the right nasal bone was then performed with a mallet and 7 mm. chisel (Fig. 4).

A standard Lynch incision was made and extended down the nasofacial groove around the ala and into the nasal vestibule (Fig. 5). Lateral osteotomy was performed under direct vision through the incision (Figs. 6 and 7). The entire right side of the nose with nasal bone attached was reflected medially, completely exposing the nasal fossa (Figs. 8 and 9). The paper plate of the ethmoid was removed down to the anterior ethmoid artery. The ethmoid cells were exenterated along the fovea back to the sphenoid. This defined the superior limit of the resection and included the entire middle turbinate in the specimen. The lacrimal sac was cut across at its widest diameter. Removal of bone was continued from the ethmoid sinus across the lacrimal fossa, through the frontal process of the maxilla, and down the

Figure 8

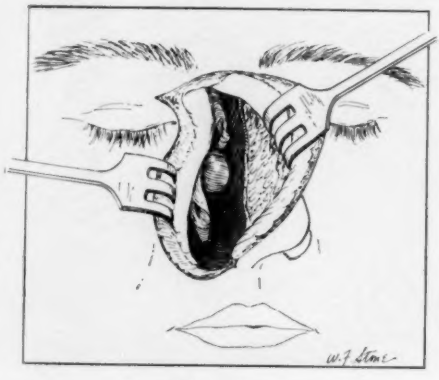

Figure 9

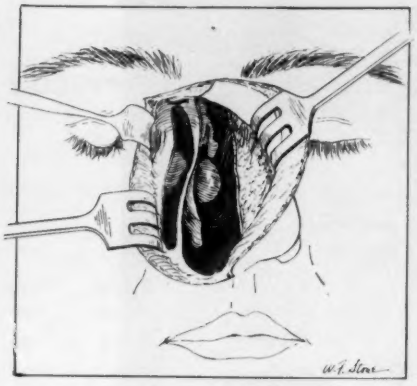

Figure 10

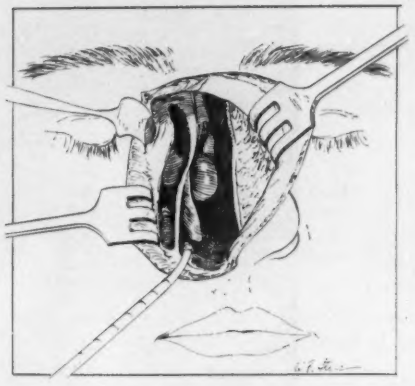

Figure 11

anteromedial aspect of the maxilla to the floor of the nose (Fig. 10). The mucosa of the antrum was elevated from the bone everywhere but where it attached to the antronasal wall (lateral nasal wall).

The next step was to elevate the mucosa of the floor of the nose (Fig. 11) subperiosteally and incise it with the electrocoagulating current, thus assuring minimal blood loss. The inferior attachment of the antronasal wall was then severed with a chisel at the level of the floor of the nose, with no further blood loss (Fig. 12). It was then possible to remove the entire antronasal wall en bloc (Fig. 13). The sphenopalatine artery was clamped and transfixed. The soft tissue and nasal bone were replaced, and the wound was closed without packing or dressing. The postoperative course was uneventful.

The patient is now 21 months postoperative and is tumor free. She is occasionally bothered by a small amount of intranasal crusting. The cosmetic result is very satisfactory (Fig. 14).

## Summary

An additional case of intranasal neuroblastoma is added to those already in the literature.

The rhinoplastic technique in lateral rhinotomy is outlined.

The likelihood of late recurrences of neuroblastoma is stressed.

Division of Otorhinolaryngology, University of California Medical Center (22).

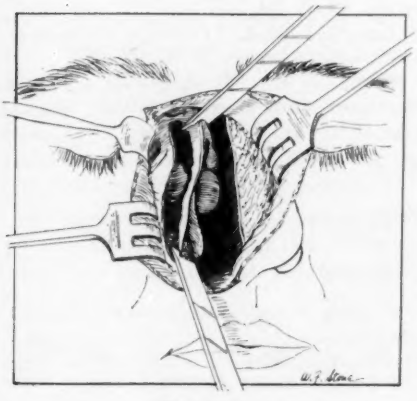

Figure 12

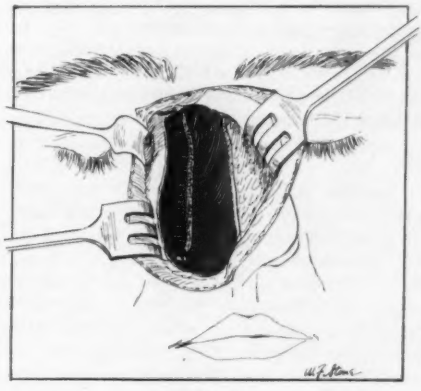

Figure 13

Figure 14

## REFERENCES

1. Bordley, J. E., and Longmire, W. P.: Rhinotomy for Exploration of the Nasal Passages and the Accessory Nasal Sinuses, Ann. Otol. Rhin. & Laryng. 58:1055-1067, 1949.

2. Cottle, M. H.: Introduction to Fundamentals of Reconstructive Surgery of the Nasal Septum and External Nasal Pyramid (syllabus).

3. Fisher, E. R.: Neuroblastomas of the Nasal Fossa, A. M. A. Arch. Path. 60:435-439, 1955.

4. Frühling, L., and Wild, C.: Olfactory Esthesioneuroepitheliomas of Louis Berger, A. M. A. Arch. Otolaryng. 60:37-48, 1954.

5. Havens, F. Z., and Thornell, W. C.: Malignant Tumors of the Nasal Cavity, Arch. Otolaryng. 40:396-401, 1944.

6. Hendrick, J. W.: Treatment of Cancer of the Nasal Cavity and Paranasal Sinuses, Surg. Gynec. & Obst. 102:322-330, 1956.

7. Laff, H. I.: Mixted Tumor of the Nose Treated by Rhinoplastic Procedure, Ann. Otol. Rhin. & Laryng. 58:488-493, 1949.

8. Lederer, F. L.; Snitman, M. F.; Skolnik, E. E., and Soboroff, B. J.: Tumors of the Nasal Cavity, Laryngoscope 67:592-604, 1957.

9. McCormack, L. J., and Harris, H. E.: Neurogenic Tumors of the Nasal Fossa, J. A. M. A. 157: 318-321, 1955.

10. Myerson, M. C.: The Management of Cancer of the Nasal Sinuses, Laryngoscope 48:615-625, 1938.

11. Schall, L. A.: Cancer of the Nose and Nasal Sinuses, Laryngoscope 53:240-245, 1943.

12. Schall, L. A., and Lineback, M.: Primary Intranasal Neuroblastoma, Ann. Otol. Rhin. & Laryng. 60:221-229, 1951.

13. Seaman, W. B.: Olfactory Esthesioneuro-Epitheliomas, Radiology 57:541-546, 1951.

14. Williams, R. I.: Utilization of Rhinoplastic Technique: Hemi-Lateral Rhinotomy, Laryngoscope 67:796-814, 1957.

# Congenital Choanal Atresia

*Report of Three Cases Occurring in One Family*

ROBERT G. MacLEAN, M.D., Los Gatos, Calif., and WILLIAM HAMMACK, M.D., San Jose, Calif.

There have been over 500 cases of congenital choanal atresia reported in the literature,[1-3] but the cause of this developmental anomaly has continued to remain obscure. Several theories have been advanced concerning the mechanism of development,[4] and among these are (1) continued dorsal growth of the nasal fossae in front of the nasopharynx, with a variable amount of mesenchymal tissue being caught between their epithelial surfaces[5]; (2) closure of the primitive nasal fossae by an epithelial plug, which then organizes forming a bony or membranous closure posteriorly[6]; (3) failure of development of the posterior end of the primitive posterior nares while there is a normal full development of the palate[2]; (4) failure of the buccopharyngeal membrane to be absorbed (this occurs in those cases of atresia which lie posterior to and against the posterior choanae),[7] and (5) embryological overproduction of tissue in the region of the choanae.[7]

What can be definitely stated, though, is that in most cases the partition blocking the posterior choanae extends vertically from the posterior margin of the palatine bone to the undersurface of the sphenoid and is attached laterally to the internal lamina of the pterygoid process of the sphenoid and medially to the vomer. The partition can be bony, membranous, or combined, but only 10%-20% are purely membranous.

A hereditary tendency has been suggested by some authors, but so far only 10 families have been reported, with the anomaly occurring in two or more members.[8-17] Therefore, the finding of another family, in which three members have the anomaly, seems interesting enough to be reported at this time.

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Read before the Section on Laryngology, Otology, and Rhinology at the 107th Annual Meeting of the American Medical Association, San Francisco, June 25, 1958.

## Report of Case

The family is Caucasian, with the father being the first definitely known member to have had choanal atresia. Some members of his mother's family had neonatal deaths, but if they had had choanal atresia it had not been recognized. The father had a complete bony atresia on the right side, and this had been surgically corrected via the intranasal approach when he was 17 years old. His only complaint prior to surgical correction had been the inability to blow his nose on this side to clear it of secretions. His first child, a full-term boy, had bilateral complete bony closure. This was a very trying time for the parents, for the condition was not diagnosed until the child was 6 weeks old, and during this time one of them watched him continually because of his frequent bouts of choking with complete asphyxia, which they would control by putting a finger in his mouth and holding the tongue down and forward. Interestingly enough, the child had quickly learned in the first few days to suck holding his breath and then breathe a few gasps. However, he did not always have good control and frequently would be unable to get any air when he tried nasal breathing. The diagnosis during this time was congenital heart disease without failure, and the child had been discharged from the hospital when one week old. At 6 weeks the true diagnosis was made, and he was promptly operated on via the transpalatal approach. He had no complications and has been a healthy normal child since.

The second (and only other) child of this father was a full-term girl, and the father noticed that her right nostril usually contained glairy mucus. Having already had two experiences with choanal atresia, he immediately suspected the condition and brought the child in for examination. After shrinking of the right nostril, probing with a catheter showed complete blockage, and this was confirmed radiographically with use of iodized oil (Lipiodol) (Figure).

## Comment

This child is getting along fine, and now, at the age of one year, the only time she has excessive drainage from her right nostril is during a cold. Our current plan is to wait until she is older, probably around 3 or 4 years, and then correct the atresia with use of the transpalatal approach.

246 W. Main St. (Dr. MacLean).

## REFERENCES

1. Cinelli, A. A.: Nasal Atresias: A Surgical Critique, Ann. Otol. Rhin. & Laryng. 35:143-151 (March) 1926.

2. Durward, A.; Lord, O. C., and Polson, C. J.: Congenital Choanal Atresia, J. Laryng. & Otol. 60:461-500 Dec.) 1945.

3. Beinfield, H. H.: Treatment of Complete Unilateral Bony Atresia of the Posterior Nares, A. M. A. Arch. Otolaryng. 53:530-539 (May) 1951.

4. McKibben, B. G.: Congenital Atresia of the Nasal Choanae, Laryngoscope 67:731-755 (Aug.) 1957.

5. Shaeffer, J. P.: Atresia of Choanae: Its Incidence and Cause, Laryngoscope 43:480-481 (June) 1933.

6. Shaeffer, J. P.: The Nose, Paranasal Sinuses, Nasolacrimal Passageways, and Olfactory Organ in Man, Philadelphia, The Blakiston Company (division of McGraw-Hill Book Company, Inc.), 1920, pp. 3-16, 37-43, 74.

7. Richardson, C. W.: Congenital Atresia of the Postnasal Orifice, Lancet 2:439-444 (Aug.) 1914.

8. Wright, A. J. M.: Congenital Bilateral Occlusion of the Choanae, J. Laryng. & Otol. 37:556-559 (Nov.) 1922.

9. Phelps, K. A.: Congenital Occlusion of the Choanae, Ann. Otol. Rhin. & Laryng. 35:143-151 (March) 1926.

10. Stewart, J. P.: Congenital Atresia of the Posterior Nares, Arch. Otolaryng. 13:570-583 (April) 1931.

11. Wilkerson, W. W., and Cayce, L. E.: Congenital Choanal Occlusion, Tr. Am. Acad. Ophth. 52:234-246 (Jan.-Feb.) 1948.

12. Shea, J. J., in discussion on Wilkerson and Cayce.[11]

13. Long, J.: Veber Choanenatresie: Hereditat Dereselben, Monatsschr. Ohrenh. 46:970-1001, 1912; cited by Wilkerson and Cayce.[11]

14. Cabaniss, J. L., cited by Wilkerson and Cayce.[11]

15. Dickson, J. C.: Congenital Atresia of Posterior Nares, Texas J. Med. 46:115-117 (Feb.) 1950.

16. McGovern, F. H.: Congenital Choanal Atresia, Laryngoscope 60:815-831 (Aug.) 1950.

17. Becker, W.; Matzker, J., and Schiffer, K. H.: Über familiäres Vorkommen verschiedener Formen von Choanalatresie, Acta oto-laryng. 47:377-382 (May) 1957.

Clinical Notes, New Instruments and Techniques

# The Combination of Antimicrobials and a Corticoid (Florotic) for Treatment of Otitis Externa

SOL A. GOLDBERG, M.D., Philadelphia

Otitis externa is a prevalent disease characterized by a multiple and overlapping etiology and a persistence in spite of intensive therapeutic measures. Inadequacies in current treatments are largely attributable to the lack of clear understanding of the underlying basis for external ear disease. In recent years, attempts have been made to examine and evaluate a variety of factors presumed to contribute to bacteriological, chemical, and pathological changes observed in external otitis.[1-3] Evidence has been presented involving contamination; elevated temperature and humidity; maceration; removal of skin lipids; sweating; trauma; absence of cerumen; allergy; age, race, and sex; pH of surface secretions; anatomical configuration; stress, and individual susceptibility as predisposing elements, although their relative importance has not been determined.[3] Obviously, a therapeutic approach directed at elimination or avoidance of etiologic factors is, at best, haphazard in view of the paucity of reliable information.

Successful therapy in otitis externa implies a practical understanding of the pathogenetic process and the outstanding symptomatology. Infections and dermatoses of the external ear present in common one or more symptoms of a changing physiology or evidence of bacterial and mycotic invasion amenable to local treatment. Acute or chronic inflammation, pruritus, edema, discharge, and/or infection have cleared on topical application of appropriate antibiotic agents combined with a corticosteroid.[3-6] The extensive use of antibiotic-corticoid formulations, however, has not proved a simple solution to the permanent cure of otitis externa. There has been a notable increase in the incidence of resistant bacterial and superimposed mycotic infection, and recent studies have stressed the role of yeasts and fungi in both acute and recalcitrant ear infection.[5,6] For long-term success, a scientific and rational approach to the treatment of disease of the external auditory canal is indicated. Selection of suitable therapeutic agents requires serious consideration of the various morphologic, bacteriologic, and pathologic changes present in order that prompt and complete control of the multiple underlying factors may be achieved.

Submitted for publication Dec. 15, 1958.

From Department of Otolaryngology, Hospital of the University of Pennsylvania.

Florotic is a combination of fludrocortisone, neomycin, polymixin B, and nystatin, E. R. Squibb & Sons, New York.

## Pathogenesis

While a complete picture of the development of otitis externa cannot be derived from present knowledge, Senturia[2,7,8] has fairly well summed up the concepts which govern a sound therapeutic approach to the disorder.

By anatomic construction and physiology, the external auditory canal defends against contamination and injury of the more vulnerable inner ear parts. The small external orifice, the secretion of water-repellent cerumen, and the convex structure of the osseous walls are all protective against harmful penetration by foreign elements. The surface-covering secretion on the meatal skin is formed primarily by sebaceous and apocrine skin glands. The fatty secretions of the sebaceous glands combine with the secretions of the apocrine glands to form highly viscous, chemically complex, pigmented waxes relatively impervious to water. For a limited time this coating, which not only covers the skin surface but also impregnates the stratum corneum, is an effective barrier, preventing intimate contact between surface cells and water or aqueous solutions. Certain waxes and cholesterol esters present in the lipid layer are, however, miscible with water, and, if contact is maintained for excessive periods, the hydrophilic oily secretions may be dissolved. In addition, many insoluble materials may be removed mechanically by the douching action of water. Percutaneous penetration and infection is facilitated by the presence of gland ducts and hair follicles in the skin. The spaces between hair shaft and follicular wall may be opened to invasion by a washing away of the greasy, scaly material by which they are normally

filled. Micro-organisms may then be carried by aqueous solutions into these spaces and reach apocrine or sebaceous gland ducts and, eventually, the gland cells.

The preinflammatory stage of otitis externa may be initiated in several ways. During diving and swimming, the douche-like action of water may remove the protective surface covering. It may be that under conditions of high temperature and high humidity some change in the amount and composition of the waxy protective cover occurs. Digging at the ear canal, presumably to remove cerumen, is undesirable in two respects. Besides removing protective secretions, this practice eventually becomes habitual whether or not there is an accumulation of ear wax. Senturia[2] suggests that under stress the apocrine glands are hyperactive, a sensation of itching develops, and the urge to dig at the ear canal is stimulated. If the lipid covering is removed and trauma occurs when temperature and humidity are elevated, the keratin absorbs moisture from the atmosphere, and edema of the stratum corneum and duct orifices develops. Normal excretion of lipids present in the follicular canals and gland ducts is prevented, and surface keratin debris accumulates in the orifices of the apopilosebaceous units further interfering with the delivery of an adequate lipid cover. Persistent itching results, inciting greater trauma, contamination and the production of an inflammatory process.

A series of pathophysiologic changes introduces a low-grade inflammatory process involving the upper layers of the stratum corneum and possibly apopilosebaceous orifices. The skin surface, deprived of an adequate covering of lipids and the antimicrobial substances believed present in normal cerumen, may exhibit a temporary shift in pH toward the alkaline side. Endogenous aerobic bacteria grow in profusion. They may easily penetrate and flourish in the orifices of the sebaceous and apocrine glands. Inflammation ensues.

Inflammatory changes in the external ear canal produce a sensation of dryness, fullness, and itching conducive to rubbing, wiping, cleaning, or scratching with fingers or foreign objects. Irritating medications are instilled promiscuously. Invariably, Gram-negative bacilli and fungi present on fingers or foreign bodies or in medications are introduced into the ear canal. The rapid growth of these organisms follows, and the various stages of acute external otitis are produced.

Examination of the ear canal at this point discloses a complete absence of ear wax, the presence of scaly adherent debris, slightly inflamed and edematous skin, and a loss of luster of the tympanic membrane. On magnification, the orifices of the apopilosebaceous units and the apocrine ducts present a "cobble-stone" appearance, and occasionally discrete papules or pustules can be seen, especially along the floor of the meatus. Uniform features of biopsy samples include hyperkeratosis, edema, acanthosis, parakeratosis, and hyperplasia of the epidermis. Epidermal lesions share many characteristics in common with atopic or contact eczemas.[2]

Where environmental temperature and humidity are continually elevated or where irritating medications have been used, a thickened and edematous epidermis is seen, and the inflammatory process extends to subepidermal areas. The canal lumen may be partially obliterated. Rapid surface growth of endogenous and exogenous organisms continues, with some exfoliation of surface layers of the stratum corneum. As the disease progresses, the diffuse inflammatory reaction involves the entire dermis, including nerve fibers, lymphatics, and blood vessels, and may even extend through natural fissures to extracartilagenous areas. Edema compresses the nerve fibers, forcing them against the perichondrium, thereby causing intense pain. Lymphatic vessels are involved, and acute cellulitis develops. Later, deep dermal abscesses with post- and infra-auricular adenitis may be seen. When smaller blood vessels are involved, vasculitis and thrombosis occur. Unless recanalization takes place promptly, the blood supply to the apocrine glands is reduced, and degeneration or irreversible destruction of these structures may be anticipated. If there is interference with nutrition of the sebaceous glands, these may also degenerate.

### Multiple Therapeutic Considerations

A number of equally important factors must be simultaneously eliminated for long-term therapeutic success in external ear disease. Dermal and epidermal edema and inflammation must be resolved and pruritus promptly checked. Alleviation of allergic reactions is desirable. Senturia[2] points out that the recurrent nature of otitis externa, the pruritus, the dry exfoliative state of the skin in the preinflammatory state, the vascular changes, and the cellular composition of focal infiltrates disclosed by microscopic examination of biopsy samples are compatible with a state of sensitization. The chances of achieving permanent cure rest firmly upon rapid and complete bacteriologic control of bacterial and mycotic infection in order that current foci are eradicated and the hazard of recurrent episodes due to drug-resistant strains is minimized.

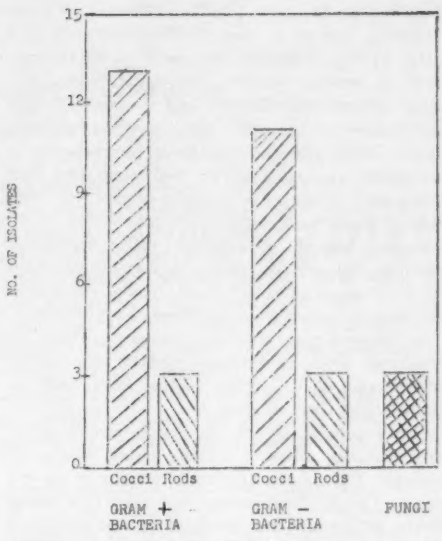
### Clinical Experience with Florotic

Florotic, a combination of highly active antibacterial and antifungal agents with a potent anti-inflammatory and antipruritic corticoid, has been developed for intensive topical treatment of

otitis externa. Florotic provides, in powder form, fludrocortisone together with neomycin, polymyxin B, and nystatin. Aqueous glycerin (9.5% glycerin in water) is furnished as a diluent. When reconstituted, each milliliter of suspension contains 1.0 mg. % of fludrocortisone, 3.5 mg. % neomycin, 10,000 units of polymyxin B, and 100,000 units of nystatin. Fludrocortisone has been reported at least 10 times greater in anti-inflammatory activity than hydrocortisone[9,10] and possesses valuable antipruritic properties as well. Neomycin and polymyxin B provide broad-spectrum control of Gram-positive and Gram-negative organisms encountered in ear infection, including such prominent offenders as Pseudomonas pyocyanea, coliforms, Proteus vulgaris, and pyogenic cocci. Preparations containing these two agents have been found more effective against mixed Gram-negative organisms in vitro than single antibiotic substances,[11] and it has been suggested that the concomitant use of these two agents may minimize the emergence of resistant strains.[12]

Florotic was prescribed as topical medication in a series of 60 patients with otitis externa seen in private practice and service of the Department of Otolaryngology at the Hospital of the University of Pennsylvania. In three of these cases, external canal involvement was secondary to otitis media. Complete bacteriologic and mycologic work-up was carried out in each case. The presence of active infection was established in 23 instances, and the distribution of isolated organisms is presented in the Figure. In addition, the remaining classifications included endocrine dyscrasia-diabetes in 3 cases, allergic dermatoses in 15, other dermatoses in 7, and a nonspecific etiology in 9.

Florotic was dispensed to each patient in this series in a quantity sufficient for 10 days of therapy. A 10-day rest period followed, and patients returned for examination every three weeks. No other therapeutic agent was employed during this evaluation, although systemic treatment for diabetes was continued where indicated. In this type of regimen, Florotic was administered for periods




Micro-organism isolated in 23 cases of otitis externa.

up to two months in duration. Prior to this study, all of these patients had failed to respond to a variety of topical medications, including single antibiotic or antifungal agents, steroids, Burow's solution, acetic acid, or antihistamines. Allergic components, where present, were not controlled by elimination diets or avoidance of known irritants. External ear disease had been present in this clinical group for periods of one month to as long as 24 years. In general, this series represented the typical cases of otitis externa likely to be encountered in a private practice.

### Results of Therapy

The clinical response achieved with Florotic in 60 cases of acute and long-standing otitis externa is presented in the Table. Results were adjudged

*Classification and Clinical Response of Sixty Cases of Otitis Externa Treated with Florotic*

| Classification | Total No. Patients | Response to Treatment | | | |
|---|---|---|---|---|---|
| | | Excellent | Good | Fair | Poor |
| Active infection | 23 | 7 | 12 | 1 | 3 |
| Endocrine dyscrasia-diabetes | 3 | 1 | 2 | 0 | 0 |
| Allergic dermatoses | 15 | 4 | 11 | 0 | 0 |
| Other dermatoses | 7 | 1 | 4 | 2 | 0 |
| External canal involvement secondary to otitis media | 3 | 0 | 2 | 0 | 1 |
| Nonspecific etiology | 9 | 1 | 8 | 0 | 0 |
| Total | 60 | 14 (23.3%) | 39 (65.0%) | 3 (5.0%) | 4 (6.7%) |

excellent in 14 cases (23.3%), good in 39 cases (65.0%), fair in 3 cases (5.0%), and poor in 4 cases (6.7%). Appraisal was based on the elimination of edema, pruritus, excoriation, desquamation, weeping, inflammation, and discharge. Where the existence of infection was initially established, smears were examined at regular intervals during treatment, as well as after medication had been withdrawn. A series of negative smears were considered evidence of satisfactory suppression of infection. Fungal involvement with Aspergillus niger as the invading organism was demonstrated in three cases. One of these cleared completely on Florotic, and no recurrences have occurred. The remaining two infections failed to respond to treatment, although additional nystatin in propylene glycol was applied locally. These have been reported as a poor response.

Three patients in this group experienced recurrent episodes after a single 10-day course of therapy. One of these followed trauma to the ear canal. Two of these patients responded to a second course of therapy, and the third was referred to a dermatologist for further study. In this series, no adverse reactions to Florotic were observed and no evidence of primary irritation or sensitization was noted.

### Comment

In our experience, Florotic proved superior to all previously employed otic preparations for the treatment of otitis externa. In addition to a gratifying clinical response in 88.3% of this series, promptness of action, continued symptomatic relief, and the virtual absence of recurrent flare-ups after treatment had been discontinued recommend Florotic for control of external ear disease. In the absence of clearly defined etiology, a therapeutic approach based on eradication of infection and alleviation of symptomatology is both rational and practical. Florotic would appear to fill these requirements.

### Summary

The pathogenesis of otitis externa is presented, and practical therapeutic problems are discussed. Clinical experience with a topical preparation containing fludrocortisone, neomycin, polymyxin B, and nystatin (Florotic) in a series of 60 patients with external ear disease is reported. A gratifying clinical response was observed in 88.3% of these cases, all of whom had failed to respond to various previously employed topical medications. No manifestations of irritations or sensitization occurred during treatment. Florotic appears to be a superior otic preparation for practical and intensive therapy in the absence of a completely defined picture of underlying factors in otitis externa.

1715 Spruce St. (3).

### REFERENCES

1. Senturia, B. H., and Liebmann, F. M.: Evaluation of Factors Which May Be of Importance in the Production of External Ear Infections, J. Invest. Dermat. 27:291 (Nov.) 1956.

2. Senturia, B. H.: Diseases of the External Ear, Springfield, Ill., Charles C Thomas, Publisher, 1957.

3. Bihari, J.: Chronic Ear Infections: Local Treatment with Hydrocortisone, Neomycin, and Polymyxin Combined, Brit. M. J. 2:623 (Sept. 14) 1957.

4. Senturia, B. H., and Alford, V.: Hydrocortisone Acetate and Neomycin in Otic Infections, Laryngoscope 64:834 (Oct.) 1954.

5. Senturia, B. H.; Alford, V., and Walsh, T. E.: Topical Hydrocortisone and Neomycin in the External Ear, Ann. New York Acad. Sc. 61:540 (May 27) 1955.

6. Holt. J. A., and Morgan, W. C., Jr.: Fungi in Otitis Externa, South. M. J. 51:144 (Feb.) 1958.

7. Senturia, B. H.: Etiology of External Otitis, Laryngoscope 55:277 (June) 1945.

8. Senturia, B. H.: Diffuse External Otitis: Its Pathology and Treatment, Tr. Am. Acad. Ophth. 55:147 (Nov.-Dec.) 1950.

9. Robinson, R. C. V., and Robinson, H. M., Jr.: Topical Treatment of Dermatoses with Steroids, South. M. J. 49:260 (March) 1956.

10. Witten, V. H.; Sulzberger, M. B.; Zimmerman, E. H., and Shapiro, A. J.: Therapeutic Assay of Topically Applied 9α-Fluorohydrocortisone Acetate in Selected Dermatoses, J. Invest. Dermat. 24:1 (Jan.) 1955.

11. Rhodes, R. E., and Ferlauto, R. J.: The Activity of Polymyxin, Neomycin, and Gramicidin Combination, Antibiotics Ann., p. 565, 1953-1954.

12. Jawetz, E.: Polymyxin, Neomycin, Bacitracin, Antibiotics Monographs No. 5, New York, Medical Encyclopedia, Inc., 1956.

# Abstracts from Current Literature

PRESENT STATUS AND RECENT ADVANCES IN SURGERY OF THE ESOPHAGUS. FRANK GLENN and BJORN THORBJARNARSON, New York J. Med. 59:280 (Jan. 15) 1959.

From the Department of Surgery, The New York Hospital-Cornell Medical Center, the authors report on 201 patients with atresia, 42.7% of whom are still alive. The first successful operation for atresia was performed in 1941. The obstetrician is held responsible for the diagnosis, dependent upon regurgitation of mucus and saliva, and the feedings immediately after ingestion. The gavage tube also helps when it meets resistance. Surgical approach is through the right chest transpleurally; one frees the lower esophagus, taking care not to injure the blood supply. If a fistula exists between esophagus and bronchus, there is usually enough length for primary anastomosis. However, occasionally, after anastomosis has healed, sudden death may come from obstruction and dilatation of the proximal segment.

Diverticula occur chiefly at the upper end of the esophagus and are seen commonly in adults, especially in the elderly. The pouch may invade the mediastinum and thus endanger perforation upon instrumentation. Operation is a one-stage procedure these days, although the two-stage was preferred in earlier times.

Epiphrenic diverticula arise 5-6 cm. above the cardia and point anteriorly. Surgery may be deferred unless symptoms become acute. There is also traction diverticula, which often occur at the level of the bifurcation of the trachea. Achalasia, cardiospasm, mego-esophagus, and idiopathic dilatation of the esophagus are words which mean about the same in descriptive value. The diagnosis is set up chiefly by history of dysphagia and regurgitation. It is found in all age groups but more commonly in women.

Hiatus hernia has three types: sliding, paraesophageal, and short esophageal. Journalists enjoy writing about "the upside-down stomach." It has been well described in the literature.

Caustic burns of the esophagus are seen in children who swallow lye and in adults who think this is a good way "to end it all." Both are so terribly wrong. The late Chevalier Jackson Sr. proclaimed loudly against household cans of lye, succeeded in forcing the manufacturers to label them "poison," and tried to teach mothers to keep such articles out of reach. This kind of "education" has had considerable success.

Carcinoma of the esophagus is said to be not common, and yet there is much being published just now about this previously "untouchable" lesion. Such malignancy is usually of the epidermoid type, is not easy to diagnose in the earlier stages, and, therefore, comes to the surgeon too late in many instances. Surgery and radiotherapy have been helpful but seldom curative in the sense of no recurrence.

Some 29 references to the literature are set down here, but there could be many more. Articles and books are coming from the press very frequently. One of the latest and best books came from authors, in the Massachusetts General Hospital, during December, 1958. It was reviewed in the A. M. A. ARCHIVES OF OTOLARYNGOLOGY in the January, 1959, issue, page 128. It is always impressive to find that intensive study of one disease or one organ can bring out such a quantity of thought, work and results.

VOORHEES, New York.

MANAGEMENT OF NASAL POLYPI. MICHAEL H. BARONE, New York J. Med. 59:423 (Feb. 1) 1959.

Barone reports from the ENT Division, of the Buffalo Eye and Ear Hospital, and the Wettlaufer Clinic. Early authorities did not associate nasal polypi with allergy. It is only in the last few years that this has been recognized. He makes three classifications: (1) mucous polyps and edematous fibromas; (2) mixed polypoid hyperplasia, glandular or angiomatous; (3) papillary hypertrophy or mulberry polyp. Polyps are seldom found on the nasal septum or inferior turbinates owing to the "compact structure of the mucous membrane." In 100 cases, examination was made under shrinkage and with the nasopharyngoscope as well as by "anterior rhinoscopy." Surgical removal without allergic management is likely to be disappointing. The steroids by mouth or as nasal sprays may be of help but must be used with caution and for short periods only. Skin testing by scratch for pollen and intradermal testing for food, bacteria, etc. are recommended. A house-dust extract is sometimes used against allergy. One

begins with low dosage, 0.01 cc., increasing by double this until 1 cc. is reached, preferably between the skin layers. In summary, nasal polypi are oftenest found with the perennial allergy. We must section each specimen to determine the pathology. Treatment should be directed to allergy. All associated conditions, inhalants, bacterial sensitivity, animal excretions, dandruff, etc. should be explored.

Dr. R. C. Grove, of Roosevelt Hospital, New York, led the discussion which is printed as an addendum to this article. It should be read by all, for it is sound thinking based on much experience, particularly in surgical removal. A beginner in a clinic is usually assigned to nasal polypi as his first try-out. Often he makes a mess of it because of bleeding, sneezing, and ineptness. This can be an arduous task. One never removes every vestige ("the roots") save by radical ethmoidectomy. Even so, there may be other sites, other foci. Recently there seems to be a recrudescence of interest in this subject. Removal by cold wire snare is, of course, the time-honored procedure. It can catch only the larger ones; tiny polyps remain and "grow again." Strangely, seldom is cauterization mentioned. It is almost the method of choice in my own experience. Electrocautery is good, but long ago I adopted chromic acid crystals fused on a copper wire. This requires patience and is slow in results, but it is very effective. If one, through shrinkage, visualizes every inlet of the nasal cavity, he can find the "nibs and nubbins" and destroy them. This may require two months or so. The causes of allergy will, of course, be taken care of pari passu.

VOORHEES, New York.

THE ACUTE RESPIRATORY PROBLEM IN INDUSTRY. NORMAN J. ASHENBURG, New York J. Med. 59:429 (Feb. 1) 1959.

This paper was read before the annual meeting of the Medical Society of the State of New York, on May 14, 1958. It is based on statistics accrued from histories of health of employees in the Eastman Kodak Company, of Rochester. Upper respiratory disease is the commonest cause of absence from work and of "decreased efficiency." It is interesting to note that there were more absentees on Mondays and Fridays than on other days of the week. The ideal method of prevention would be to isolate every person who evidences symptoms while at work. Since this is impossible, an effort is being made to teach employees general hygiene, how contagion occurs, and the effects of wet and cold, dust and smoke. The hope is expressed that eventually a virus may be found from which a vaccine can be made which will be effective in prevention of "the uncommon cold." Nothing is said of present methods of treatment, save the abuse of antibiotics. These do not give much aid against virus conditions. However, when the commoner germs are present and there are "complications" anywhere in the body, a well-chosen antibiotic is in order. Five figures and 42 references help to illustrate the text.

VOORHEES, New York.

THE CLINICAL SIGNIFICANCE OF HOARSENESS. BERNARD J. WATTIKER, New York J. Med. 59:484 (Feb. 1) 1959.

Wattiker quotes Chevalier Jackson to say that there are "some 50-odd causes of hoarseness!" Many, if not most, are simply a complication of "just a cold." These clear with or without treatment in a few days. It is the chronic ones, which last over periods of weeks or months, which give us concern. Here we have the "diagnostic triad": Is it syphilis, tuberculosis, or cancer? However, there are benign conditions, such as polypi and papilloma, in which the voice is husky or unclear. We must know which is present. Indirect laryngoscopy examination is recommended to the general practitioner as a sine qua non, a type of examination he is in duty bound to cultivate. Epithelioma is the commonest form of malignancy, and, if taken early, it can have a good prognosis. Paralysis of the left cord is commonly found in lesions of the aortic arch. Carcinoma of the thyroid, bronchogenic carcinoma, and mediastinal lymphoma also have hoarseness as a symptom.

ABSTRACTER'S COMMENT: Examination of the larynx by mirror is much easier said than done. Gagging is almost sure to be present, and unless the throat is quiet one can see nothing. Retching and vomiting are common. Patients with short thick neck are most difficult to examine. The laryngologist will anesthetize the pharynx and larynx and wait a few moments before proceeding. Unless one can view every nook and cranny of the larynx, examination is indeterminate. With all due respect to the occasion, I think we are asking too much of the harried general practitioner to do indirect laryngoscopy.

VOORHEES, New York.

CANCER OF THE PARANASAL SINUSES. GEORGE A. SISSON and NORMAN E. JOHNSON, New York J. Med. 59:609 (Feb. 15) 1959.

From the State University of New York College of Medicine comes this "report," read before the Annual State Meeting, in New York, in May, 1958.

Cancer of the sinuses is frequently mismanaged. Why? Difficulty of diagnosis. Pains in and about the face and head are among the commonest symptoms. The diagnosis is often "sinusitis" or "migraine" or just "idiopathic." X-ray studies may be negative or doubtful, and specimens of tissue sent to pathologists may be equally divisive and, therefore, indeterminate. If the orbit seems involved it takes courage to advise complete enucleation, which is pretty sure to be denied by the patient until there is an inoperable state. As to diagnosis, the frontals are seldom malignant. We must study, therefore, the antra and ethmoids. X-ray films may be only slightly cloudy. However, antral washings with Papanicolaou stains may be helpful if one is lucky, but they may be fairly negative. We can do an exploratory antrotomy, Caldwell-Luc procedure. This is ordinarily a simple matter and may be done "under local." It is sure fire for diagnosis. Radium or x-ray therapy may precede or follow operation, perhaps both. If we do not achieve relief from pain—no matter how good we think our surgical result is—we may be in disfavor with the patient. A review of the literature, compels the thought, "Only a few cases of sinus carcinoma can be cured." A discussion by Dr. John S. Lewis, of New York, printed with the article, adds much to its substance.

VOORHEES, New York.

BRONCHOGENIC CARCINOMA HERALDED BY HEMOPTYSIS AND IGNORED BECAUSE OF NEGATIVE CHEST X-RAY RESULTS. LOUIS SCHNEIDER, New York J. Med. 59:632 (Feb. 15) 1959.

Dr. Schneider, of Mt. Vernon, N. Y., works in the Washington Heights Chest Clinic, Bureau of Tuberculosis, New York City Department of Health. X-rays of the chest are routine these days but are often misleading or inconclusive. They may be negative even in the presence of a small intrabronchial cancer which casts no shadow. A detailed report on five patients furnishes the text, from which conclusions are drawn. Ten references are offered from the literature. Fortunately, spitting of blood often brings the patient to a doctor. This should suggest a direct-tube study and biopsy. Even so, one may fail to find the lesion, but we have at least done all we can to locate it. Now that surgical removal of a whole lobe may lead to relative cure, prolongation of life is in sight. However, metastasis is also to be thought of but luckily may not occur for many months or years. The five-year delay is all one can hope for. Any period beyond that is considered "lucky." Nevertheless, if we cannot eliminate constant cough, hemoptysis, and pain, the patient will be dissatisfied and the surgeon disappointed. We are dealing here with imponderables. The surgeon does not heal, and Nature sometimes refuses to do so. We must not depend entirely upon x-ray or radium, but they are the best aids to surgery we have at the present time.

VOORHEES, New York.

CARDIOVASCULAR COLLAPSE FOLLOWING ENDOTRACHEAL INTUBATION. ANESTHESIA STUDY COMMITTEE, New York State Society of Anesthesiologists, New York J. Med. 59:654 (Feb. 15) 1959.

This is a case report of cardiac arrest following intubation—management and recovery. A 73-year-old white man had several attacks of syncope, with falls and injuries. A diagnosis of bilateral hypersensitive carotid sinuses was made. General anesthesia was given, and a Magill endotracheal tube was introduced easily. Breathing stopped, and cyanosis began. There was no pulse count or blood pressure reading to be obtained. Diagnosis was cardiac arrest. The chest was opened, and massage of the heart was instituted. Epinephrine, atropine, and other medications were administered (details are in the article). Improvement was followed by regression, then improvement, and again regression, as if in cycles. Management brought about complete recovery. In some way pressure stimuli on the carotid sinuses, left pulse, caused heart block. This can be vagal or sympathetic in nature. One may apply electrodes to the chest, "an external pacemaker." If the beat is not restored within 10 seconds, thorocotomy must be carried out with manual cardiac compression and relaxation at 50 to 70 per minute.

ABSTRACTER'S COMMENT: This is the nearest we shall ever come to "raising the dead." That the procedure works is one of the modern marvels based on vivisection studies and research. At the moment it seems that every surgeon must learn this technique. It is an alarming condition when one is faced with cardiac arrest. Time is of the essence. Every

step must be quick and certain. Surgery of the chest is an amazing development both as a curative and as a life-saving measure, but it is not for amateurs!

VOORHEES, New York.

CANCER IN MID-CENTURY. LEONA BAUMGARTNER, New York J. Med. 59:664 (Feb. 15) 1959.

This is No. 18 in the series of cancer alerts and was read over WNYC, under the auspices of the New York Academy of Medicine and the New York City Cancer Committee. Dr. Baumgartner is City Commissioner of Health. She calls attention to the influence of information and education in helping to dispel fear and secrecy from the public mind. The secrecy under which a president of the United States had a cancer of the jaw operated on on the yacht of a wealthy man more than 50 years ago, is compared with open statements in press and on radio today. Unfortunately, she states that the president was McKinley! Not so. It was Grover Cleveland. The yacht was that of Commander Eli C. Benedict. The surgeon was Dr. J. D. Bryant. The entire matter was rewritten in a popular magazine article some months ago. However, the fact remains that prolongation of life makes it seem that cancer is on the increase among the aged. This is a statistical matter. The aged are now more frequently under medical study and supervision; therefore, diagnosis of cancer is likely to be made earlier, with resultant "cure." Dr. Baumgartner says, "Cancer of the lung is today on the increase." Periodic x-rays of the chest should be the rule in all persons over 40. The family doctor must encourage complete physical check-up on given dates, one's birthday, for example. Doctors lead; the public must accept and follow their advice. This status is being gradually obtained.

VOORHEES, New York.

THE CELLULAR DETECTION OF CARCINOMA OF THE ESOPHAGUS. T. GEPHART and R. M. GRAHAM, Surg. Gynec. & Obst. 108:75-82 (Jan.) 1959.

It is the authors' contention that earlier diagnosis of esophageal carcinoma will do much to improve the survival rate in this condition and that the study of exfoliated cells may be the means of arriving at this goal. With use of a Levin tube, of No. 12, 14, or 16 size, while the patient swallows normal saline, aspirations are obtained with a 100 cc. glass syringe from several levels. The specimens are spun down and the sediment smeared, with immediate fixation in 95% ethyl alcohol and staining by the Papanicolaou method. The skill and experience of the cytologists making the study are, of course, vitally important, as are the techniques of aspiration and slide preparation.

In a group of 64 patients with primary carcinomas of the esophagus, correct positive washings were obtained in 89% of the cases and false negatives in only 5%.

There were 25 patients with adenocarcinoma of the cardia whose diagnosis was confirmed by surgical exploration. Positive washings in this group were previously obtained in 16 patients, negative results in 5, and doubtful in 4. It is believed that the less accurate results in this group may reflect the greater tendency for squamous cells to desquamate.

Of 58 patients with nonmalignant lesions of the esophagus, there were no positive washings, but, of these, 39 were negative, 17 doubtful, and 2 unsatisfactory.

The cytological characteristics of malignant cells are well illustrated. Washings from the esophagus by means of the Levin tube have given more accurate results than washings obtained through the esophagoscope. The value of follow-up studies at regular intervals after treatment of patients with carcinoma of the esophagus is emphasized for detecting early evidence of recurrence.

FRIEDBERG, Chicago.

VOCAL BREAKDOWN AND ITS CAUSE AND CURE. WILLIAM C. ZERFFI, Ann. Otol. Rhin. & Laryng. 67:360-363 (June) 1958.

It is pointed out that the voices of many outstanding singers deteriorate long before their possessors show declining physical powers. The singer who has amassed the necessary experience to be at his best all too frequently finds that his vocal powers have declined to a point where he can merely indicate what he would like to do. He has reached the pinnacle of his artistry, but his voice no longer responds to his wishes.

Zerffi states that the true cause of this muscular deterioration is not overuse of the vocal muscles but rather a method of vocal production which deprives the vocal muscles of their proper exercise. This is due to reliance on the powerful external muscles in producing tone, and so the internal vocal muscles gradually lose power until a point is reached where attempts at singing have to be abandoned, a state of true vocal breakdown.

This condition is not due to overuse or overstrain of the vocal muscles but to weakening caused by lack of exercise. The cure for this condition is elimination of the "outside help" the organ has been receiving and then exercise of the internal muscles until they recover their strength and elasticity. It is unfortunate that too few teachers have the sound technical understanding of the actions and interactions of the parts of the throat concerned with the production of tone so necessary for proper advice to the student on how to best eliminate vocal faults.

STEELE, Kansas City, Kan.

BEETHOVEN'S DEAFNESS. BRIAN F. MCCABE, Ann. Otol. Rhin. & Laryng. 67:192-206 (March) 1958.

At a time when Ludwig van Beethoven, one of the world's greatest composers, could not hear a note of music, he was able to compose the monumental "Ninth Symphony," "Missa Solemnis," and "Fidelio." The cause of his deafness has been a source of controversy for more than a century.

The author presents a careful scrutiny of historical data and autopsy reports in an attempt to shed new light on the specific cause of the deafness. Some have attributed the hearing loss to otosclerosis, others to typhus, allergy, or smallpox. The proponents of the otosclerotic theory point out that the use of a drumstick, held in the teeth at one end and applied to the piano at the other, by which Beethoven listened to his music as he composed it, indicated conductive deafness. This bit of evidence is reported by only one obscure observer and is not mentioned by the multitude of other biographers and correspondents.

If otosclerosis and other forms of middle ear deafness and endolymphatic hydrops can be excluded on the basis of a careful autopsy and biographic material, one is left with the possibility of eighth nerve deafness or central deafness. Central deafness can be discredited, as, even late in the disease, the composer had no difficulty interpreting sounds once they reached the brain stem.

Considering what is known of Beethoven's medical background and the pertinent necropsy findings, it is apparent that marked eighth nerve atrophy was present, which produced chronic, progressive, perceptive deafness. Recorded gross pathologic findings indicate a chronic granulomatous inflammation, producing a basilar piarachnoiditis and eighth nerve arteritis, capable of eventuating in auditory neural atrophy. The author concludes, "Syphilis is the most likely cause of this low grade meningitis which existed without other central nervous system signs."

STEELE, Kansas City, Kan.

THE CLINICAL MASKING LEVEL. FRED HARBERT, Ann. Otol. Rhin. & Laryng. 67:332-340 (June) 1958.

According to the author, recognition of the various shortcomings of commercially available masking sounds to eliminate the conductively deafened ear should stimulate study and development of more effective methods. It is advocated that study of narrow-band sounds of various configurations and the use of insert receivers instead of conventional phones might be productive. It has been shown that cross masking is proportional to the area of application of sound; therefore, by applying the sound to a small area, as is possible with insert receivers, higher sound intensity may be delivered to the ear to be masked without cross masking.

Furthermore, utilization of narrow-band noise instead of broad-band (white) noise reduces the ineffective portion of the total stimulus. Of further possible interest might be the Stenger principle, use of the same sound for masking and stimulus by variation of one intensity modulation to permit differentiation. At present, confusion of stimulus and masking tone by the patient generally limits the effectiveness of the Stenger principle as a clinical test technique.

STEELE, Kansas City, Kan.

THE EFFECTS OF HYPOXEMIA UPON THE ELECTRICAL RESPONSE OF THE COCHLEA. W. L. GULICK, Ann. Otol. Rhin. & Laryng. 67:148-169 (March) 1958.

In the cat, the cochlear response is resistant to oxygen want; i. e., a reduction in hemoglobin saturation from 100% to 35% reduces the magnitude of the response less than 5 db. However, levels of hemoglobin saturation below 35% reduce the magnitude of the response more drastically (up to 20 db.).

There is good recovery of cochlear response if saturation levels do not go below 35%. With levels below this point, only partial recovery is noted after restoration of normal oxygen, perhaps owing to irreversible damage to the hair cells, as permanent impairment of cochlear

response exists. The net loss in cochlear response following oxygen deprivation is related directly to the severity of deprivation. In some instances it was found that temporary enhancement of cochlear response followed states of hypoxemia.

In the animals studied, mild hypoxemia was compensated for by increased cardiac output and increased efficiency in oxygen exchange, and the cochlear response easily recovered. It is emphasized by the author that the data obtained from the cat may *not* be directly transferred to man.

STEELE, Kansas City, Kan.

THE EFFECTS OF AIR PRESSURE OF THE EAR. W. E. RAHM JR., W. F. STROTHER, G. LUCCHINA, and W. L. GULICK, Ann. Otol. Rhin. & Laryng. 67:170-177 (March) 1958.

Studies have shown that introduction of abnormal pressure into either the external meatus or middle ear of the cat produces a deleterious effect upon cochlear response. Whether the pressure be positive or negative makes little difference, inasmuch as ±4 in. of water pressure will decrease the magnitude of the cochlear response over the range of low and middle frequencies. The higher frequencies, however, have been found to be relatively immune to pressure effect until high deviations from normal, i. e., ±16 in. of water and above, have occurred.

The studies have suggested that altered air pressure in the external meatus or the middle ear cavity affect sound transmission mainly by changing the tension characteristics of the tympanic membrane. Therefore, regardless of the magnitude of pressure change, sound transmission should remain essentially unaffected as long as the tension of the drum remains unchanged.

To test this hypothesis, the authors introduced pressure simultaneously into the external meati and the middle ear of 15 cats and thereafter tested the cochlear response for several frequencies under both positive and negative pressure effects.

After analysis of the data obtained, it was apparent that the critical factor affecting sound transmission is the differential pressure existing in the middle ear and external meatus. The absolute magnitude of the pressures acting upon the tympanic membrane is of little consequence as long as they are matched and thereby relieve the drum from physical distortion.

STEELE, Kansas City, Kan.

PAPILLOMATOSIS OF LARYNX AND BRONCHI: CASE REPORT WITH THIRTY-FOUR-YEAR FOLLOW-UP. R. L. MOORE and R. LATTE, Cancer 12:117-126 (Jan.-Feb.) 1959.

This is a report of a case of multiple bulky squamous-cell papillomas of the bronchi in a woman who 34 years previously was treated for recurrent laryngeal papillomas. The pulmonary lesions were treated surgically twice, and the patient is alive and in good general condition, but with persistent disease in the remaining portion of both lungs, six years after her second thoracic operation. New laryngeal papillomata have recently developed.

The authors give an excellent review of the association of laryngeal papillomas and similar lesions in the lower respiratory tract. When the lesions involve the bronchi they have a tendency to bleed, to cause obstruction and, as a result, to form cavities. Thus they may be confused clinically with tuberculosis, especially when the lesions are located in the upper lobe as in the case reported. Recurring hemoptyses in a patient with a preceding history of laryngeal papilloma should suggest the possibility of bronchial papillomatosis. Familiarity with this entity and with its natural history is important, since the surgical treatment, contrary to that of true bronchogenic carcinoma, should be most conservative. Since these lesions grow slowly, it is not unlikely that some of them may be tolerated for a lifetime without any radical treatment and without serious complications.

Finally, the authors speculate on the mechanism of the "spread" of the disease from the larynx down into the lower tracheobronchial tree. Whether these growths are produced by a virus or by some other unknown tumor-inducing agent, it would be logical to assume that neoplastic changes might result anywhere in the respiratory epithelium, in a manner somewhat analogous to that of the multicentric papillary neoplasms of the urinary tract. It is suggested that this is a more acceptable theory than that of "transplantation" or "aerial metastasis" due to detached fragments that would become aspirated and seeded in other portions of the respiratory tract. Excellent illustrations of pathological processes involved in the patient under consideration are available.

FRIEDBERG, CHICAGO.

THE ROLE AND ACTION OF ENVIRONMENTAL AGENTS IN THE PATHOGENESIS OF LUNG CANCER: I. AIR POLLUTANTS. P. KOTIN and H. L. FALK, Cancer 12:147-163 (Jan.-Feb.) 1959.

In pointing out the proven world-wide increase in the frequency and the mortality from lung cancer, the authors analyze some of the consistent findings that appear to have etiological implications. Thus, it is known that there is a greater frequency of lung cancer in men than women, that there is a greater liability to the development of lung cancer in urban residents than in rural residents, that there is increased incidence associated with a history of prolonged excessive cigarette smoking, and that there may be some etiological influence of the influenza epidemic of 1917-1920.

The authors assume that bronchogenic cancer develops subsequent to the action of multiple factors, and they have undertaken a study of atmospheric pollution and its possible role as a causative factor. Their analyses of the atmospheric components, including 3,4-benzpyrene and allied hydrocarbons, are of considerable interest. These irritants were used in studies on animals exposed to test environments after which the tracheobronchial epithelium was made available for in vitro studies. The action of irritants upon ciliary activity and upon mucus secretion is recorded. In addition, a study of human lungs removed at autopsy in the Los Angeles area was also carried out.

This is a most absorbing and scientifically interesting study in which the authors show that carcinogenic aliphatic oxidation products present in the atmosphere in aerosol form are capable of respiratory tract irritation. The broad spectrum of agents carcinogenic for visceral organs in experimental animals and apparently for those in man should cause one to proceed with caution in attributing the absolute dominance of any one agent over another. They conclude with a statement that it is perhaps safest to regard the development of lung cancer as the end-state of a series of sequential changes that require the presence of a carcinogenic agent, environmental host-modifying factors, and the innate susceptibility of the host. All links in this chain are not of equal magnitude, and it is proposed that, instead of searching exclusively for a cause of lung cancer, it might well be more rewarding to investigate the series of changes that constitute its pathogenesis.

FRIEDBERG, CHICAGO.

## Books

**The Year Book of Ear, Nose and Throat** (1958-1959 Year Book Series). Edited by John R. Lindsay, M.D. With a section on Maxillofacial Surgery, edited by Dean M. Lierle, M.D. and William C. Huffman, M.D. Price, $7.50. Pp. 395, with 114 illustrations. The Year Book Publishers, Inc., 200 E. Illinois St., Chicago 11, 1959.

**Eye, Ear, Nose and Throat Manual for Nurses.** Eighth Edition. By Roy H. Parkinson, M.D. F.A.C.S. Price, $3.85. Pp. 237, with 82 illustrations, including 2 in color. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1959.

**Ciba Foundation Symposium: Biosynthesis of Terpenes and Sterols.** Edited by G. E. W. Wolstenholme, O.B.E., M.A., M.B., B.Ch., and Cecilia M. O'Connor, B.Sc. Price, $8.75. Pp. 311, with 102 illustrations. Little, Brown & Company, Medical Book Department, 34 Beacon St., Boston 6; J. & A. Churchill, Ltd., 104 Gloucester Place, W. I., London, 1958.

# News and Comment

## ANNOUNCEMENTS

**Courses in Basic Sciences.**—The 1959-1960 Home Study Courses in the Basic Sciences related to ophthalmology and otolaryngology, which are offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on Sept. 1 and continue for a period of 10 months. Detailed information and application forms can be secured from Dr. William L. Benedict, executive secretary-treasurer of the academy, 15 2d St. S. W., Rochester, Minn. Registration should be completed before Aug. 15.

**Casselberry Award.**—A sufficient fund having accrued from the Casselberry Fund for encouraging advancement in the art and science of laryngology and rhinology, this sum is now available in part or as a whole for a prize award. Theses must be in the hands of the Secretary of the American Laryngological Association prior to Jan. 1 of any given year.

The award is a prize of money with accompaning certificate signed by the officers of the American Laryngological Association. The sum of money will be agreed upon by the Council of the association after the manuscript has been evaluated by the award committee. It may be awarded in whole or in part among several contestants.

Eligible contestants may be (1) hospital interns, residents, or graduate students in rhinology and laryngology; (2) a person with an M.D. degree who is actively practicing or teaching rhinology and laryngology in the Americas; (3) any scientific worker in the field of rhinology and laryngology.

Manuscripts shall be presented to the Secretary of the association under nom de plume which shall in no way indicate the author's identity. There shall also be a sealed envelope bearing the nom de plume and containing a card showing the name and address of the contestant, which the Secretary will keep in his possession.

Manuscripts must be limited to 5,000 words and must be typewritten in double-spacing on one side of the sheet. The thesis shall not have been published elsewhere before submission.

The successful thesis shall become the property of the American Laryngological Association, but this provision shall in no way interfere with publication of the thesis in the journal of the author's choice. Unsuccessful contributions will be returned promptly to their authors.

The award, which will be made at the Annual Meeting of the American Laryngological Association, will be based on (1) originality of material, (2) scientific and clinical value, (3) suitability for this award, and (4) method of presentation as to style, illustrations, and references.

The maximum amount of the award shall not exceed $200.

**Institute on Occupational Hearing Loss.**—This course, presented by Colby College for seven consecutive years, is designed to train otologists and others interested in this problem in initiating and conducting hearing conservation programs in noisy industries. In order to allow for maximum individual instruction, course enrollment is limited. The diversity of experience of the faculty members, assembled especially for this course, provides an unusual opportunity for personal consultation on any aspect of occupational hearing loss. The dates of the course are Aug. 17-22, 1959, and the fee of $200 includes tuition, board, and room. Requests for further information should be made to William A. Macomber, Colby College, Waterville, Maine. Frederick T. Hill, M.D., Director; Joseph Sataloff, M.D., Associate Director.

# Directory of Otolaryngological Societies *

## FOREIGN AND INTERNATIONAL

### Canadian Otolaryngological Society
### (Société Canadienne d'Otolaryngologie)

President: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Secretary: Dr. Donald M. MacRae, 324 Spring Garden Rd., Halifax, N. S.
Meeting: Sheraton-Brock Hotel, Niagara Falls, Ontario, Oct. 9-10, 1959.

### Venezuela Otorhinolaryngology Society

President: Dr. Alfredo Celis Pérez.
Secretary: Dr. Jesús Miralles.

### International Association of Allergology

President: Dr. Samuel M. Feinberg, 303 E. Chicago Ave., Chicago 11.
Secretary-General: Dr. José Quintero Fossas, Paseo 313, Vedado, Havana, Cuba

### International Bronchoesophagological Society

President: Dr. Jo Ono, Tokyo.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

### International College of Surgeons, Section of Ophthalmology and Otolaryngology

President: Dr. John R. Lindsay, 950 E. 58th St., Chicago.
Secretary-Treasurer: Dr. Louis Savitt, 3403 W. Lawrence Ave., Chicago 25.
Meeting: 24th Annual Congress, Palmer House, Chicago, Sept. 14-18, 1959.

### International Congress of Audiology

General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.
Place: Leyden, Netherlands.

### International Course in Paedo-Audiology

General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.
Place: Groningen, Netherlands.

### Mexican Society of Otolaryngology

President: Dr. Rafael Giorgana
Secretary: Dr. Carlos Valenzuela, Monterrey 47-201, Mexico 7, D. F.

### Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Paul H. Holinger, Chicago.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

## NATIONAL

### American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Victor R. Alfaro, Washington, D. C.
Secretary: Dr. Walter E. Heck, San Francisco.

### American Academy of Ophthalmology and Otolaryngology

President: Dr. LeRoy A. Schall, 243 Charles St., Boston.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

### American Board of Otolaryngology

President: Dr. Gordon D. Hoople, 1100 E. Genesee St., Syracuse 10, N. Y.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

### American Broncho-Esophagological Association

President: Dr. Verling K. Hart, 106 W. 7th St., Charlotte, N. C.
Secretary: Dr. F. Johnson Putney, 1712 Locust St., Philadelphia 3.

### American Laryngological Association

President: Dr. Fred W. Dixon, 2060 E. 9th St., Cleveland.
Secretary: Dr. James H. Maxwell, University Hospital, Ann Arbor, Mich.

### American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Gordon D. Hoople, 1100 E. Genesee St., Syracuse 10, N. Y.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

SECTIONS:

Eastern.—Chairman: Dr. Joseph L. Goldman, New York.
Southern.—Chairman: Dr. James T. King, Atlanta, Ga.
Middle.—Chairman: Dr. Alfred J. Cone, St. Louis, Mo.
Western.—Chairman: Dr. Robert C. McNaught, San Francisco, Calif.

### American Rhinologic Society

President: Dr. Kenneth H. Hinderer, 402 Medical Arts Building, Pittsburgh 13.
Secretary: Dr. Robert M. Hansen, 1735 N. Wheeler Ave., Portland, Ore.
Annual Clinical Session: Oct. 8-9, 1959, Illinois Masonic Hospital, Chicago.
Annual Meeting: Oct. 10, 1959, Belmont Hotel, Chicago.

### American Otological Society, Inc.

President: Dr. Robert C. Martin, 384 Post St., San Francisco 8.
Vice-President: Dr. Henry L. Williams, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Lawrence R. Boies, University Hospitals, Minneapolis 14.

### American Otorhinologic Society for Plastic Surgery, Inc.

President: Dr. Raymond S. Rosedale, 610 N. Market St., Canton 2, Ohio.
Secretary: Dr. Joseph G. Gilbert, 75 Barberry Lane, Roslyn Heights, N. Y.
Meeting: Oct. 11, 1959, Conrad Hilton Hotel, Chicago.

### American Society of Facial Plastic Surgery

President: Dr. Oscar J. Becker, Chicago.
Vice-President: Dr. Sam H. Sanders, Memphis.
Secretary: Dr. Samuel M. Bloom, 123 E. 83d St., New York 28.
Treasurer: Dr. Joseph C. Miceli, Brooklyn.
Meeting: Oct. 15, 1959, Chicago.

### American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. Joseph W. Hampsey, Grant Building, Pittsburgh 19.
Secretary-Treasurer: Dr. Daniel S. DeStio, 121 S. Highland Ave., Pittsburgh 6.

### Otosclerosis Study Group

President: Dr. E. P. Fowler Jr., 180 Fort Washington Ave., New York 32.
Secretary-Treasurer: Dr. Arthur L. Juers, 1018 Brown Building, Louisville 2.

### Society of Military Otolaryngologists

President: Lt. Col. Stanley H. Bear (MC), USAF, Maxwell AFB, Ala.
Secretary-Treasurer: Capt. Maurice Schiff (MC), U. S. N., U. S. Naval Hospital, Oakland, Calif.

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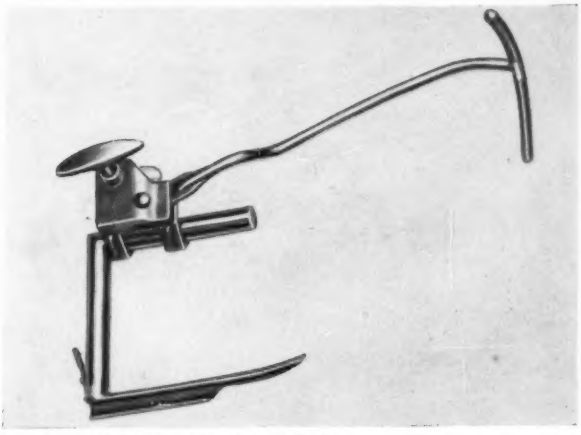

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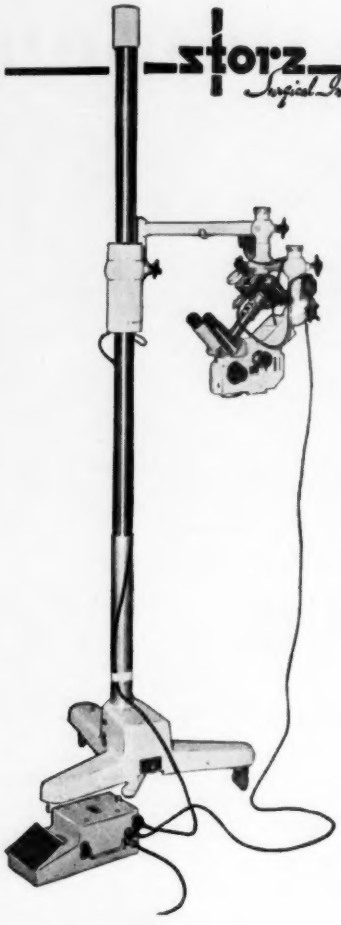

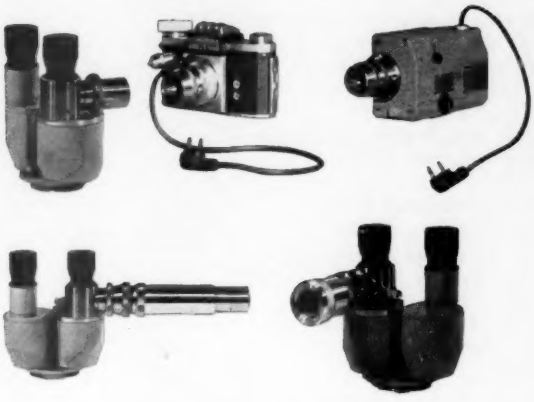

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